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of
NORTH AMERICA

CHICAGO NUMBER

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THE SURGICAL CLINICS of NORTH AMERICA

CHICAGO NUMBER

SYMPOSIUM ON CLINICAL ADVANCES IN SURGERY

FOREWORD

It has been a revered practice of these Clinics to present symposia of papers from leading surgical centers wherein surgical technic is featured

In preparation of this issue a deliberate effort has been made to emphasize original contributions on a variety of subjects of interest to the practicing surgeon. To be sure, the strides that have been made in recent decades have been by those seeking challenges solved first in the laboratory and only later in the operating room. May these be judged by such accomplishments as fit the members of a profession devoted to advancement.

KARL MEYER, M D
Consulting Editor

ACUTE INTUSSUSCEPTION IN INFANTS AND CHILDREN

An Analysis of Ninety-five Cases in the Cook County Children's Hospital

HARRY A. OBERHELMAN, M.D., F.A.C.S.* AND JOHN B. CONDON, M.D.†

DURING the twenty one year period from 1925 to 1945 inclusive there were ninety five patients with acute intussusception admitted to the Cook County Children's Hospital among a total of 141,580 admissions. It is our purpose to present an analysis of these ninety five cases (Table 1) and to compare our results with those of similar institutions both in this country and abroad. It is common knowledge that acute intussusception is the most common cause of intestinal obstruction in infants and children and also the most serious. This is clearly reflected by the high mortality rates shown in the many excellent reports on this subject. We hope that our studies will, as all others have, contribute something to lower this discouraging mortality rate. At the same time we are encouraged by the progressive lowering of the mortality rates by improved methods of treatment over the years in the various institutions (Tables 2 and 3).

ETIOLOGY

In considering the cause of intussusception one is impressed with the striking absence of demonstrable causative factors. Ladd and Gross⁸ found no cause in 95 per cent of their patients, Hogg and Donovan¹³ found none in 83 per cent, and in our series no cause was found in 82.1 per cent. Age, sex, seasonal variation, dietary changes and perverted peristalsis are invariably mentioned as relative causative factors. Fiske¹⁴ considers perverted peristalsis to be due to incoordination of the autonomic nervous system at the ileocecal region where a dual sympathetic and parasympathetic supply gives way to a single sympathetic control.

As to age (Table 4) 68.6 per cent of the patients in our series were under 1 year, of which 60.6 per cent were under 9 months and 36.3 per cent under 6 months. 20.2 per cent were between 1 and 2 years, 9 per cent between 2 and 3 years and 2 per cent were 3 years old or over. The youngest was 2 weeks old the oldest 15 years. These figures compare favorably with those reported by the various authors in Table 2. There were sixty five males and thirty females a ratio of two to one.

* Professor of Surgery Loyola University School of Medicine Senior Attending Surgeon and Director of the Department Mercy Hospital Loyola University Clinics Attending Surgeon Cook County Hospital Chicago

† Instructor in Surgery Loyola University School of Medicine, Chicago

(Table 1) As to race there were forty six white, forty five Negro and in four instances the race was not mentioned

TABLE 2—ILLUSTRATING THE PROGRESSIVE LOWERING OF MORTALITY BY IMPROVED METHODS OF TREATMENT IN SOME OF THE LEADING CHILDREN'S HOSPITALS HERE AND ABROAD

Institution	Authors	Periods of Observation	No. of Cases	Mortality Per Cent
London Hosp. Children's Division	Ferna and Lindsay	1903-08 1909-14 1915-20	138 149 113 — 400	49.2 27.5 76.6 — 34.75
Guy's Hosp. London	Cloze ²	1901-17 1919-27	131 106 — 237	40.0 20.0 — 55.4
Philadelphia Children's Hosp.	Brown ³ Robbins ⁴	1915-24 1924-31	31 31 — 65	64.5 35.3 — 49.2
Sidney, Australia Children's Hosp.	Clubb ⁵ Halsey ⁶	1921 1937	144 142 — 286	32.0 4.9 — 19.0
New Haven City Hosp.	Gordon	1917-27 1928-38	28 16 — 44	37.5 6.25 — 23
Boston Children's Hosp.	Ladd and Gross ⁷	1900-07 1908-37 1933-39	282 90 112 — 484	37.0 14.0 12.5 — 26.9
Kronprinsessan Louisa Vårdsanstalt Stockholm	Nyborg ⁸	1920-34 1935-41	24 81 — 108	17.0 5.0 — 7.3
Cincinnati General Cincinnati Children's Hosp.	Gibbs and Sutton ⁹	1927-37 1937-42	56 36 — 92	41.6 8.3 — 30.4
Children's Memorial Hosp. Chicago	Musl	1933-43	105	16.1
Babes Hosp. New York	Bolling ¹⁰ Hogg and Donovan ¹¹	1923 1927-45	50 123 — 173	30.0 13.0 — 21.5
Cook County Children's Hosp. Chicago	Oberhelman and Condon	1925-31 1932-38 1939-45	13 18 68 — 99	53.8 16.6 13.2 — 19.1

As to seasonal variation—out the months of the year and late summer monsoonable factor, the high

TABLE 1—SEX, RACE AND MORTALITY INCIDENCE IN INTUSSUSCEPTION

Race	Total Number	Males			Females			Total Mortality, Per Cent
		No	Deaths	Mortality Per Cent	No	Deaths	Mortality, Per Cent	
White	46	31	8	25.8	15	1	6.6	20.0
Negro	15	30	7	23.3	15	3	20.0	22.2
Unknown	4	4	0	0.0	0	0	0.0	0.0
Totals	95	65	15	23.0	30	4	13.3	19.1*

* Mortality computed on basis of the number treated which includes four recurrences in three of the ninety-five patients.

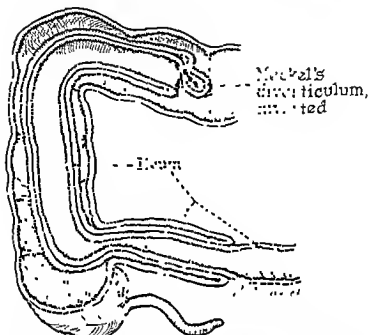


Fig 1—A Meckel's diverticulum forming the apex of an intussusception

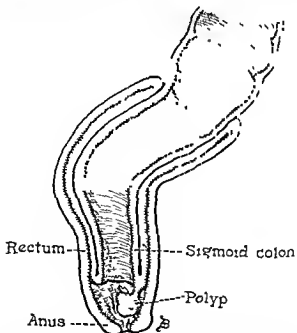


Fig 2.—A sigmoid polyp causing a sigmoidorectal intussusception.

TABLE 3—THE INCIDENCE OF INTUSSUSCEPTION ACCORDING TO SEX AND THE MORTALITY IN PERIODS OF SEVEN YEARS EACH

Years	No of Cases	No Treated	Male	Female	Deaths	Mortality Per Cent
1925-31	13	12	12	1	7	53.2
1932-38	16	16	12	2	3	16.6
1939-45	61	60	41	23	9	13.2
Total	90	99	65	30	19	19.1

* With recurrences

TABLE 4—AGE, SEX AND MORTALITY INCIDENCE

Age	Male	Female	No of Cases	No Treated	Deaths	Mortality Per Cent	Remarks
0-3 months	4	2	6	6	2	25.0	3 moribund on adm
4-6 months	13	13	26	26	4	14.2	
7-9 months	18	8	26	24	6	25.0	
10-12 months	4	1	5	6	1	12.5	
1-2 years	13	3	16	20	5	25.0	
2-3 years	8	2	10	9	1	11.1	
Over 3 years	1	1	2	2	0	0.0	
Totals	61	30	91	99	19	19.1	

TABLE 5—THE ANATOMIC PATHOLOGIC FINDINGS FOUND AT SURGERY CONSIDERED AS DEMONSTRABLE ETIOLOGICAL FACTORS

Findings	No	Remarks	Deaths
No cause	78		14
Meckel's diverticulum	6	1 case with 2 recurrences 4 resections 2 died	3
Mesenteric glands	3		0
Congenital malformation of meso-colon	2		2
Intestinal polyps	2	1 in sigmoid 1 in ileum	0
Adhesive bands over front of terminal ileum	1		0
Inverted appendiceal stump	1		0
Aberrant pancreatic tissue	1	Ileum resected containing aberrant pancreatic tissue	0
Swallowing of $\frac{3}{4}$ ounce turpentine	1		0
Total	90		19

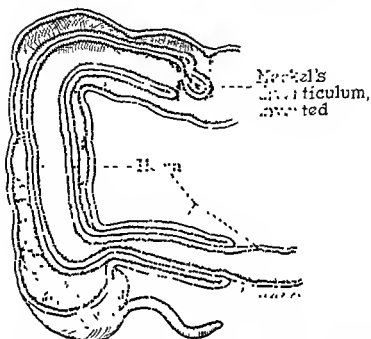


Fig 1—A Meckel's diverticulum forming the apex of an intussusception

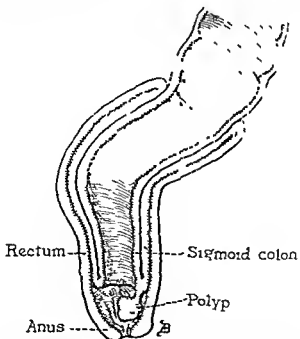


Fig 2—A sigmoid polyp causing a sigmoidorectal intussusception.

In the records of seventeen patients (Table 5) there was some cause mentioned for the intussusception. In six patients a Meckel's diverticulum (Fig 1) was found, in three enlarged mesenteric lymph glands

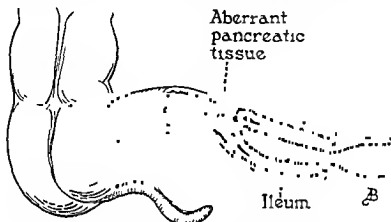


Fig 3—A nodule of aberrant pancreatic tissue forming the apex of an ileo-ileal intussusception

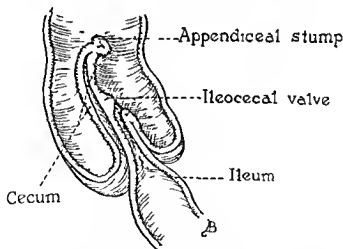


Fig 4—A recently invaginated appendiceal stump forming the apex of an appendico ceco-colic intussusception

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four patients, one had an adhesive band passing over the front of the terminal ileum, another had a nodule of aberrant pancreatic tissue¹⁹ in the ileum (Fig. 3), a third had a recently invaginated appendiceal stump (Fig. 4) and the fourth was reported to have swallowed $\frac{1}{2}$ ounce of turpentine on the day before the onset. Further reference to some of these cases will be made subsequently. No mention was made of intestinal lymphoid hyperplasia or mobile cecum.

SIGNS AND SYMPTOMS

The patients comprising our series were for the most part healthy robust children. The onset of symptoms was acute, characterized by cramping pain, vomiting, bloody stools and usually a palpable mass. About 50 per cent had some sign of abdominal distention and over 30 per cent were admitted in shock or impending shock. Except in those patients who had been ill for several days the temperature, blood picture and urinary findings were within relatively normal limits.

TABLE 6 —RELATIVE FREQUENCY OF CARDINAL SYMPTOMS OF INTUSSUSCEPTION

Symptoms	Present	Absent	Not Mentioned
Vomiting	89	3	3
Pain	84	8	3
Bloody stool	82	12	1
Palpable mass	77	14	4
Signs of obstruction	40	47	8
Shock	34*		

* Thirteen patients with obstruction were in shock on admission.

The symptom most frequently recorded in our series was vomiting (Table 6). This occurred in eighty nine patients and in eight the vomiting was reported as projectile. Gordon⁷ reported the vomiting as projectile for his entire series of forty two patients. In four patients ill for two days or more the vomiting was fecal and in another it was bloody.

Pain, cramplike in character, was present in eighty four patients and usually preceded the vomiting. Between the paroxysms of pain some of the children appeared entirely well. It will be noted that five patients who vomited had no pain. Musul¹² calls attention to the pres-

ence of a mass, on the gloved finger of the examiner, or following an enema. In most instances blood did not appear before twelve to sixteen hours.

In the records of seventeen patients (Table 5) there was some cause mentioned for the intussusception. In six patients a Meckel's diverticulum (Fig 1) was found, in three enlarged mesenteric lymph glands

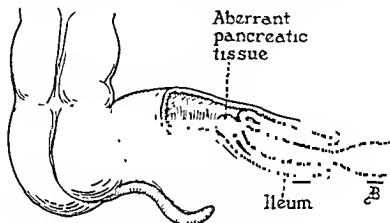


Fig 3—A nodule of aberrant pancreatic tissue forming the apex of an ileo-ileal intussusception

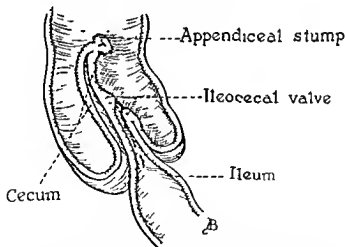


Fig 4—A recently invaginated appendiceal stump forming the apex of an appendiceo-ceco-colic intussusception

were reported, in two a congenital malformation of the mesocolon was described, in two pedunculated polyps were noted, one in the distal ileum and the other in the sigmoid colon (Fig 2). Of the remaining

the remaining twenty one shock undoubtedly was initiated by the sudden onset of severe pain and vomiting. As a matter of fact we feel that shock or impending shock as an early symptom is not adequately stressed in the literature. Ladd and Gross³ reported shock in 10 per cent of their patients. In this same connection these authors stress listlessness another notable sign that is often unrecognized. In our series this symptom was apparently not appreciated since it received only scant mention.



Fig 6—A typical roentgenogram of an ileo-ileo-colic intussusception

DIAGNOSIS

The diagnosis of acute intussusception was correctly made in all but two patients of our entire series. In sixty seven the symptom triad of pain, vomiting and bloody stools was present. These patients also had palpable masses. In the remaining twenty eight one and sometimes two of the above named signs were absent. Rectal examination was made in sixty three patients and in twelve masses were palpable. Diagnosis was further aided in thirty five babies roentgenologically by either a scout film or barium enema. The barium enemas were used

after the onset of pain. The blood was usually of the "currant jelly" type so aptly designated by Montgomery.¹³

Palpable masses were found in seventy seven patients or 81 per cent in fourteen patients no masses were palpable and in four none was mentioned. Figure 4 represents a regional diagram of the various locations of the masses and the incidence of their occurrence in these locations. Ladd and Gross³ reported the presence of palpable masses in 84 per cent. The mass is oval movable as a rule and moderately tender. It may shift its position in the abdomen in the course of a few hours. In five of our patients with bloody stools no palpable mass was felt. Subsequent surgery however confirmed the presence of a mass in the

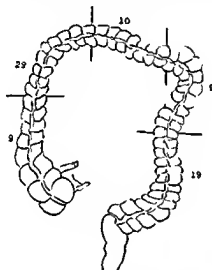


Fig 5—Illustrating the frequency of location of palpable masses

presence of distention or rigidity much difficulty is encountered in palpating a mass. Evidence of this is quite striking inasmuch as twelve of the eighteen patients without a palpable mass had signs of intestinal obstruction. In some cases the mass lies under either costal margin

patients. In nine patients the mass was palpable after twenty-four hours while in all the remaining twenty-one patients it was palpable after twenty-four hours. This indicates that obstructive signs need not necessarily be late signs of intussusception.

Of the thirty-four patients showing signs of shock or impending shock on admission thirteen had signs of intestinal obstruction also. In

program for this condition, it is essential that such a program be under the joint supervision of the pediatrician and the surgeon. Usually the patients are dehydrated from vomiting and lack of fluids, and require a restoration of fluid and electrolyte balance. This is accomplished by the administration of fluids parenterally, using 5 per cent glucose in either saline solution or distilled water, and if the patient is critically ill plasma and blood transfusions are administered. In infants under 1 year a cut down at the ankle is made and a cannula inserted for slow continuous drip until adequate fluids are retained orally. In children over 1 year the veins are larger and usually venipuncture permits adequate fluid administration. If no veins are available the subcutaneous route and the so called rectal drip or both will provide ample fluid intake. In addition to administering adequate fluids, we have of more recent years employed a Levin tube to keep the stomach and upper intestine decompressed by continuous Wangen-

TABLE 8—TYPES OF INTUSSUSCEPTION FOUND AT SURGERY AND THEIR MORTALITY

Types	No. Cases	Deaths	Mortality Per Cent
Ileocecal or ileocolic	64	12	18.7
Ileo-ileocecal or colic	8	1	12.5
Ileo-ileal	4	0	0.0
Colo-colic	4	0	0.0
Appendico-ceco-colic	1	0	0.0
None found already reduced	3	0	0.0
Type not mentioned	4	3	75.0
Total	88	16	18.1

We have discontinued the use of morphine entirely in infants and use it only occasionally in children.

Anesthesia.—Ether anesthesia, the open drop method, was used in seventy of the eighty eight operations, and is clearly the anesthesia of choice. In ten patients ether was necessary as a supplement to local anesthesia, which was used in eleven patients. In one patient cyclopropane, and in another vinyl ether, was used. In five patients the type of anesthesia was not mentioned. It is essential that complete relaxation be obtained because the intussusception may be located a considerable distance from the incision.

Incision.—Contrary to the principle that abdominal incisions should

mainly for diagnostic rather than therapeutic purposes, even though an occasional intussusception was reduced by the enema. A typical roentgenological picture is seen in Figure 6. As to the two patients in whom the diagnosis was incorrectly made clinically, one was treated for infectious diarrhea and died. Autopsy later disclosed an acute intussusception. In the other patient the preoperative diagnosis was a pelvic abscess which proved at surgery to be intussusception.

TREATMENT

Notwithstanding the commendable over all mortality rates of Hipsley⁶ and of Nyborg⁹ who employed hydrostatic and acrostatic methods combined with surgery when necessary, most of us consider acute intussusception an emergency surgical disease. This view is based (1) on the uncertainty of complete reduction with hydrostatic pressure in which delay would be serious and (2) on the danger of causing overdistention and rupture of an already damaged bowel.

When we group our series into nonoperative and operative groups we do not mean that the reduction of the intussusception in the nonoperative group was so planned but that there was no other alternative.

TABLE 7—INTUSSUSCEPTION AT COOK COUNTY CHILDREN'S HOSPITAL 1923-1916, THE ENTIRE SERIES AND A COMPARISON OF TREATMENTS

Treatment	No. Cases	No. Treated	Deaths	Mortality Per Cent
Nonsurgical	10	11	3	27.2
Surgical	83	88	16	18.2
Totals	93	99	19	19.1

Nonsurgically Treated Group—There were ten patients (one suffering a recurrence) in the nonsurgical group (Table 7). Two patients were moribund on admission and died several hours later. In another patient the intussusception had reduced spontaneously. In six patients the intussusception was reduced by means of a barium enema which was used as a diagnostic aid but brought about recovery. In the last patient the clinical diagnosis of infectious diarrhea was wrong. At autopsy an acute unreduced intussusception was found. The mortality in this group was 27.2 per cent.

Surgically Treated Group—In the surgically treated group there were eighty-five patients representing eighty-eight operations with a mortality of 18.2 per cent (Table 7).

Preoperative Care—In order to execute successfully a surgical

ously invaginated appendiceal stump was the apex of a recurrent intussusception four days later. On the other hand, Peterson¹⁶ feels that

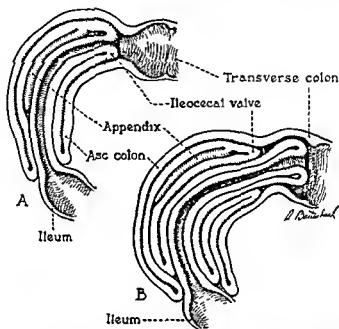


Fig 8—A, Ileo-cecocolic and, B, ileo-ileo-cecocolic intussusception.

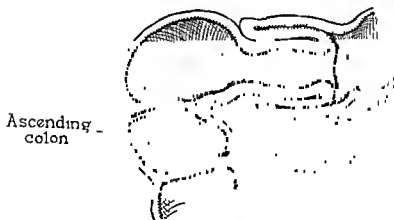


Fig 9—Colo-cecocolic intussusception of the transverse colon.

appendectomy should be performed in all ileocecal intussusceptions. In one patient (Fig. 2) a polyp of the sigmoid was the apex of a sig-

be made over the pathologic viscus, in intussusception, a migratory lesion, the incision should always be made in the right lower quadrant. This is where the intussusception invariably takes its origin and, regardless of its migration, it is where its reduction terminates. In our series a relatively long right lower rectus incision was made to permit exploration of the other quadrants of the abdomen. The incision through the peritoneum must be made with caution because in forty patients of our series there was evidence of intestinal obstruction.

The various types of intussusception found at surgery and their frequency are presented in Table 8. Over 81 per cent occurred at the junction or in the region of the junction of the ileum and cecum (Fig 7, B and Fig 8, A and B). The nomenclature for this group is frequently confusing because of the various combinations that may occur.

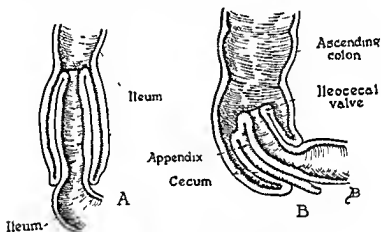


Fig 7—A Ileo-ileal and B ileo-cecal intussusception

Few intussusceptions occurred in the ileum alone (Fig 7, A) or in the colon alone (Fig 9). In three patients the intussusception was found reduced at the time of surgery. This may occur as the result of a

Postoperative Care—Postoperative care is considered as important as the surgery itself. The routine employed in the preoperative phase is carried over into the postoperative phase. Fluid and electrolyte balance must be maintained. Plasma and blood transfusions are especially indicated on the day of surgery and again on the third or fourth postoperative day when hypoproteinemia so often develops. Postoperative distention must be controlled by continuous suction until evidence of bowel function has returned. At this time fluids and foods may safely be administered orally. Penicillin, the sulfonamides and vitamins are routinely used and have proven helpful.

Recurrences—In our series there were four recurrences in three patients. In one patient the first intussusception was reduced by a barium enema but recurred one week later at which time reduction was made by operation. In the second patient the first intussusception

TABLE 10—ANALYSIS OF OPERATIVE PROCEDURES IN THE RESECTED GROUP

Type of Operation	Number	Recovery	Deaths	Mortality Per Cent
Lehey Mikulicz	6	3	3*	50.0
Resection of ileum primary anastomosis	5	2	3	60.0
Primary resection of cecum and ileum	1	1	0	0.0
Short-circuiting only	1	1	0	0.0
Resection of Meckel's diverticulum	1	1	0	0.0
Totals	14	8	6	42.8

* Two died on the operating table.

was reduced by operation and at the same time an appendectomy was performed (Fig. 4). Four days later the second intussusception occurred and at surgery the invaginated appendiceal stump was found to be the apex of the intussusception. In the third patient the first intussusception was reduced surgically. Six months later a recurrence developed which was reduced by barium enema. Three weeks later a second recurrence developed which was then reduced surgically. At this time a Meckel's diverticulum was found. This was probably the cause of the recurrences in the third patient.

Mortality Factors—Our overall mortality for the ninety-five patients was 19.1 per cent (Table 7). Of the nineteen who died three were moribund on admission and no surgery was considered; five died on the operating table; eleven died within thirty hours postoperatively from shock; and four died in less than five days from toxemia and generalized peritonitis.

moidorectal intussusception which had presented itself at the anus. Through an anal speculum the polyp was excised and the intussusception reduced by digital manipulation.

Resections—In fourteen patients the intussusception was either irreducible or the bowel wall was beyond viability after reduction. These patients required resections. Peterson¹⁶ reported the first successful resection of an intussusception. The various methods of resection used in our series are shown in Table 10. It is difficult to state a method of choice because any type of resection in such critically ill infants carries an exceedingly high mortality. We feel that when an infant survives resection, survival is due far more to the better general condition of the patient than to any merit one operative procedure may have over the other. When resective methods are contemplated we feel that the level of the irreducible lesion should dictate the

TABLE 9—THE VARIOUS OPERATIVE PROCEDURES EMPLOYED AND THE MORTALITY IN THE SURGICALLY TREATED GROUP

Surgical Procedures	No. Cases	Deaths	Mortality Per Cent
"	3	2	66.7
"	33	6	18.2
"	3	1	33.3
"	6	1	16.6
Proctectomy	1	0	0.0
Polyp ligated at rectum	1	0	0.0
Information not given	2	2	100.0
Resections	11	6	54.5
Totals	58	16	27.6

method. For those requiring resections of the cecum and terminal ileum the Lahey-Mikulicz exteriorization procedure is our method of choice. Six patients in our series had resections by this method with three deaths of which two occurred on the operating table. For those requiring resections of the ileum only we feel that primary resection

¹⁶ Musil¹¹ the procedure appears to have been the first.

Postoperative Care.—Postoperative care is considered as important as the surgery itself. The routine employed in the preoperative phase is carried over into the postoperative phase. Fluid and electrolyte balance must be maintained. Plasma and blood transfusions are especially indicated on the day of surgery and again on the third or fourth postoperative day when hypoproteinemia so often develops. Postoperative distention must be controlled by continuous suction until evidence of bowel function has returned. At this time fluids and foods may safely be administered orally. Penicillin, the sulfonamides and vitamins are routinely used and have proven helpful.

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Mortality Factors.—Our overall mortality for the ninety-five patients was 19.1 per cent (Table 7). Of the nineteen who died three

Complications—There were complications encountered in only nine patients of our series treated surgically. These were as follows: three viscerations, three cases of bronchopneumonia, two wound infections and one intestinal obstruction. All nine patients recovered.

DURATION OF SYMPTOMS

The duration of symptoms is unquestionably the greatest single factor responsible for the high mortality rate. This is shown most convincingly in our series in Table II. The mortality rose from 2.3 per cent for the first day to 15.7 per cent for the second day and to 40 per cent for the third day. These figures are in conformity with those reported by many authors. Cordon⁷ however takes exception to this view. In his series of forty-two patients with an average symptom period of thirty-six hours he feels that the mortality was not appreciably affected by the symptom time factor because some deaths occurred even though operation was early.

TABLE II—MORTALITY BASED ON DURATION OF SYMPTOMS

Duration of Symptoms	No. of Cases	Deaths	Mortality per Cent
0-24 hours	43	1	2.3
24-48 hours	19	3	15.7
48-72 hours	20	8	40.0
72-120 hours	10	5	50.0
Over 5 days	3	2	66.7
Totals	95	19	19.9

* Mortality determined on basis of total cases treated.

are dependent as a rule on the probable prognosis. In our series patients who died had visible obstruction was not regarded as a sign of

the mesenteric
coverly from

shock is the result of dehydration toxemia and intestinal obstruction response to treatment often fails

The intussusceptions (Table 8) sustaining the highest mortality in our series 18.7 per cent were in the ileocecal region and those yielding the lowest mortality occurred in either the ileum alone or colon alone Gibbs and Sutton¹⁰ on the contrary found the highest mortality in the "ileo ileal" group and their lowest in the "ileocecal" group

According to Ladd and Gross³ the farther the mass had progressed toward the anus the higher was the mortality This was not borne out in our studies In our series the level to which the intussusception had advanced bore no constant relationship to mortality If we use Figure 5 which shows the frequency and location of palpable masses in seventy six patients and accept them as intussusceptions then we find our lowest mortality of 10.5 per cent in the left lower quadrant group followed by 11.1 per cent each for the left upper and right lower quadrants 20 per cent for the epigastric group and the highest 20.7 per cent for the right upper quadrant group These mortality rates might vary somewhat if the locations of the intussusceptions of the nineteen patients with no palpable masses of whom six died were known and distributed accordingly We however feel that the mortality rates would not be appreciably altered Obviously then we cannot conclude that the further the intussusception had advanced the higher is the mortality In support of this we might add that in two of our patients the intussusception had appeared at the anal orifice Both recovered after surgery

The only explanation we can offer on the basis of our studies is that *regardless of the location of the intussusception it is the duration of the symptom period that determines the mortality* Our statistics further show that the distance the intussusception has progressed is not necessarily related to the duration of the symptom as is often assumed To illustrate this finding we note that the patients with intussusceptions in the epigastric region had a mortality of 20 per cent and an average symptom period of 49.7 hours The patients with the lesion in the left lower quadrant had a mortality of 10.7 per cent and an average symptom period of 25.1 hours Therefore we cannot state that the more caudad the intussusception the longer the symptom period

Is Meckel's diverticulum a mortality factor in intussusception? It was found in six patients four of whom required resection In two patients the ileum and cecum were resected with death following in both cases In a third the segment of ileum bearing the intussusception was resected with an end to end anastomosis followed by recovery A fourth patient had a resection of the diverticulum only followed by recovery In the fifth and sixth patients simple manual reduction only was required One of these patients died and one recovered There were three deaths and three recoveries a 50 per cent mortality This

result shows Meckel's diverticulum to be a significant mortality factor

The mortality among the fourteen patients comprising the resected group was 42.8 per cent. Perrin and Lindsay³ reported forty nine resections in 1921 with a mortality of 81.6 per cent. Woodhill¹³ in 1938 had six cases requiring resection with a 50 per cent mortality. In forty three resections by Ladd and Gross⁹ thirty three patients died, exhibiting a mortality of 76.7 per cent, and in 1946 Hogg and Donovan¹² reported a mortality of 55 per cent in nine resections. It is encouraging to see a gradual reduction in mortality throughout the country by means of improved surgical technique and judgment, better preoperative and postoperative care, and paren-

and whole vitamins. By virtue of these modern advances there have been but three deaths among the last forty five patients with a mortality of 6.6 per cent. It may be stated again that no matter how up to date our facilities may be for the treatment of intussusception we have no means as yet by which we can successfully combat a long symptom period.

SUMMARY AND CONCLUSIONS

1 This study represents an analysis of ninety five infants and children admitted to the Cook County Children's Hospital for acute intussusception during a twenty-one year period (1925 to 1945 inclusive) and is the first comprehensive study of its kind from this hospital.

2 A comparison in table form has been made of the mortality rates of intussusception for a number of the leading children's hospitals at the same time showing the progressive lowering of the mortality rates in "Period of Years" as improved means of therapy become available.

3 Our series has contributed no more than those of many other

in 17.9 per cent some cause was mentioned. Meckel's diverticulum being noted six times.

6 The most frequent symptoms was vomiting followed in order by pain and the presence of bloody stools. In sixty seven patients the classical symptom triad was present. Palpable masses were felt in seventy seven patients. Signs of intestinal obstruction were present in forty

7 Correct clinical diagnosis was made in ninety three of the ninety five patients largely on the basis of symptoms and physical findings. Only thirty five patients had some form of x ray studies and these were largely among the earlier patients in our series.

8 We consider acute intussusception to be primarily a surgical emergency, notwithstanding the success some authors have obtained by hydrostatic methods. Furthermore acute intussusception is best treated when it is made the joint responsibility of the pediatrician and the surgeon.

9 Eighty five patients had eighty eight operations performed by twenty seven different surgeons. Fourteen surgeons performed one each.

10 Ether anesthesia was used in seventy of the eighty eight patients and is the anesthetic of choice. In ten patients it was used as a supplement to local anesthesia.

11 By far the majority of intussusceptions occur at the ileocecal junction and in our series this type was associated with the highest mortality rate.

12 The greatest single factor responsible for the high mortality rate was the duration of symptoms especially when associated with signs of intestinal obstruction.

13 In our series the distance to which the intussusception had advanced was not determined necessarily by the duration of symptoms nor was the mortality necessarily determined by the distance to which the intussusception had progressed.

14 Resections resulted in a mortality rate of 42.8 per cent for the fourteen patients requiring resection. This rate is considerably lower than those reported by most authors.

15 We recommend the Lahey Mikulicz resection method when the terminal ileum and colon require resection but for segmental resections of the ileum alone a primary end to end anastomosis seems preferable. We also believe that the short circuiting operation has definite merit.

16 Meckel's diverticulum is a definite mortality factor to be reckoned with as indicated by the fact that four of the six patients with Meckel's diverticulum required resections.

17 The factors accounting for recurrences in our series consisted of a Meckel's diverticulum in one and a recently invaginated appendiceal stump in another.

18 We do not recommend routine appendectomy in operations for intussusception.

19 The greatly improved preoperative, operative and postoperative program in the more recent years has been of material assistance in progressively lowering the mortality rate but if the symptom period is forty eight hours or more such a program is of little avail.

20. The surgical mortality rate for the twenty-one year period was 18.2 per cent, but for the last forty-five patients in our series the mortality was only 6.6 per cent.

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SUPPURATIVE CHOLANGITIS

WARREN H. COLE, M.D., F.A.C.S.*

INTRODUCTION

SUPPURATIVE cholangitis may be defined briefly as an infection of the bile ducts. In most cases it probably starts in the extrabiliary bile ducts, but tends to proceed upwards into the liver, particularly if there is obstruction to the flow of bile. As a matter of fact, suppurative cholangitis rarely occurs except when obstruction exists. As will be discussed later, the great danger associated with suppurative cholangitis is the development of multiple liver abscesses which are serious and represent a threat to life. Because of this danger, there is usually indication for immediate treatment, as discussed later, although on many occasions the patient has sporadic chills which may be followed by intervals of freedom from symptoms.

ETIOLOGY

The most common bacteria producing the infection are *Escherichia coli*, streptococcus and staphylococcus. As a matter of fact, the infection is usually of a mixed type, although cultures taken at various intervals may not reveal all three of these bacteria at the same time.

As stated above, the infection rarely develops unless obstruction of the bile duct is present.

1. *Stone in the common duct* is no doubt the most common type of obstruction giving rise to suppurative cholangitis. However, it is the one type which may clear spontaneously, largely because of the ball valve action of the stone. The obstruction is not complete and persistent as it is in most other obstructions, such as carcinoma of the head of the pancreas. Nevertheless, surgical treatment, as discussed later, is usually indicated as emergency treatment.

2. *Carcinoma of the pancreas* is not recognized as being a common cause of suppurative cholangitis, but I have recently seen several cases in which this lesion was the etiologic factor.

3. *Stricture of the common duct* almost always gives rise to suppurative cholangitis sooner or later. There may be fluctuations in intensity of the infection dependent upon variation in the degree of obstruction. The duration intervening between onset of development of obstruction and cholangitis is no doubt dependent upon the question as to whether

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or not an antecedent infection was present. If for example infection was present in the biliary system including the common duct the lesion would no doubt develop at an early date following development of obstruction. Usually the stricture is secondary to trauma sustained at operation on the biliary tract. On a few occasions it appears that there is an unusual type of inflammatory reaction which we might designate as *obliterative cholangitis* which can produce serious obstruction resulting in suppurative cholangitis. It is possible that on some occasions an abscess may develop postoperatively about the duct thus giving rise to a serious inflammation in the wall. Such a mechanism would appear to be the most likely explanation of the so-called obliterative cholangitis.

Congenital cystic dilatation of the common duct may give rise to suppurative cholangitis but not frequently because no antecedent infection exists.

The three patients mentioned in the preceding paragraph were three of five patients with strictures of the common duct for which we anastomosed a loop of jejunum to the open end of the duct; the anas-

to the lumen and an anastomosis made between the two loops of jejunum about 10 inches from the bile duct anastomosis. One of the five patients died before leaving the hospital. Barium given by mouth was found to regurgitate up into the intrahepatic bile ducts in all four patients who survived the operation. One of the patients (a woman) had relatively few symptoms for two years then suddenly developed severe chills and fever with latent but no gross jaundice. This woman was operated upon twelve days after onset of symptoms; no obstruction was present although she had purulent bile in the common duct. She died a few days later and upon examination multiple liver abscesses were found. Two of the three remaining patients developed recurrent attacks of chills and fever a few weeks after we had anastomosed the hilar duct to the loop of jejunum; therefore a second operation was performed at which the ascending limb of jejunum was transected (turning in each end) in each case. Following this pro-

cedure which entirely obliterated regurgitation (as proven by x ray) the symptoms disappeared. The patients have had no symptoms referable to their biliary tract since that time. The fourth patient (also a woman) had mild attacks of chills and fever for a year or two following the repair, but has been asymptomatic for the past year. The three patients just described prove, to my satisfaction at least, that suppurative cholangitis *can be produced by regurgitation in the absence of duct obstruction*, although on most occasions partial obstruction of the duct or stoma is present.

Recently Zaslow and Counseller² have likewise called attention to the large percentage of cases of suppurative cholangitis occurring in the absence of obstruction to bile flow. They also stressed the fact that suppurative cholangitis may occur without chills and fever, diagnosis in these cases was confirmed by autopsy.

PATHOLOGY

The initial source of the infection is probably in the wall of the common duct although proof of infection may more readily be obtained from the presence of purulent material in the lumen of the common duct. It is well known that infection does not take place by progression of intestinal contents upward through the sphincter of Oddi, therefore ascending infection through the sphincter up the common bile duct can be excluded as a significant factor in the development of infection.

It is true however, that after infection once develops in the wall of the common duct it tends to infect the contents of the lumen and likewise tends to progress upwards into the liver particularly if there is obstruction to the flow of bile. The wall of the common duct becomes thickened, edematous and fibrosed. Microscopically, invasion of polymorphonuclear and lymphocytic cells are noted. Granulation tissue and fibrous tissue are encountered in various stages of resolution. This same pathologic process progresses upward with the infection but

infections of polymorphonuclear cells at or near the termination of the bile capillaries and enlarge depending upon the degree of obstruction and the treatment instituted. They may coalesce into one large abscess, but usually there are numerous small abscesses scattered throughout the rest of the liver even though coalescence does take place.

The contents of the common bile duct may or may not be frankly purulent. On one occasion (Fig. 10) the bile in the common duct appeared practically normal although it contained bacteria and the patient sustained immediate relief of symptoms following choledochostomy. The presence of white bile itself is no indication as to the presence of infection since white bile is mucus secretion arising from the

wall of the duct (or gallbladder) It is an expression of obstruction but retains a rather transparent glary appearance until it is infected When infection develops it becomes opaque loses its opalescent appearance and becomes thicker The appearance of white bile or colorless exudate in the common duct simply indicates that this colorless fluid is being formed at a greater pressure than the formation of bile by the liver Almost invariably, bile will be found in the intrahepatic ducts particularly if little time is allowed for secretion of bile to be resumed Thus resumption of bile flow can actually be demonstrated on the operating table after the obstruction is relieved On some occasions however it may take twenty four hours or more for the secretory function of the liver to be resumed

CLINICAL MANIFESTATIONS

1 *Chills and Fever*—The first symptom noted by the patient may be a chill, which of course is associated with fever As intimated previously, these chills vary greatly in frequency, depending upon the constancy of obstruction and many other factors including the immunologic response of the patient However, fever without chills is frequently present A chill may be an expression of sudden and rather massive bacterial invasion

2 *Jaundice and Acholic Stools*—Since obstruction is usually pres
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suggest that the obstruction is only partial or that it is intermittent Intensity of jaundice varies greatly depending upon many factors

3 *Pain*—The presence or absence of pain depends on the type of lesion producing the obstruction or infection With very few exceptions the patient will complain of pain if the infection is secondary to

produced by ordinary gallbladder disease Perhaps more commonly the pain is located in the epigastrium If the infection is produced by stricture pain is variable and although usually present, it is usually of less intensity When the condition is caused by carcinoma of the head of the pancreas pain is not commonly encountered On

nausea and vomiting are common. Between attacks they are uncommon. However, these two manifestations are so inconstant that they are not of much diagnostic value.

5 Weakness and Prostration—During the acute attack weakness and prostration are pronounced. If jaundice and fever persist beyond the acute attack, weakness will be still more intense. If the condition is allowed to persist over a period of many weeks, loss of weight, weakness and prostration will of course be present to an advanced degree.

6 Positive Physical Findings—With few exceptions the liver is enlarged. Mild tenderness in the right upper quadrant is likewise present in the majority of cases, but muscle spasm is uncommon. On many occasions there is little or no tenderness over the liver; therefore abdominal findings may be of little diagnostic aid in establishing a diagnosis. The enlargement of the liver will produce slight elevation of the diaphragm on the right, which may be detected by percussion and an x-ray film. Fever and jaundice have already been mentioned as prominent findings. Tachycardia is fairly pronounced; the degree being dependent on the amount of fever.

7 Laboratory Findings—The most pronounced positive laboratory finding is leukocytosis. The white blood cell count is usually elevated to a marked degree, on occasions being as high as 25,000. Anemia is likewise common and in general the degree is related to the duration and intensity of infection. Examination of the urine and stool for bile is usually positive and negative respectively, but of course is dependent upon the absence or presence of obstruction of the common duct. The icterus index will be of value in determining the intensity of jaundice.

TREATMENT

It can now be stated emphatically that surgical drainage of the common duct is essential in the treatment of suppurative cholangitis. When penicillin was instituted a few years ago it was thought that suppurative cholangitis might be controlled by medical treatment. However, I have had sufficient experience to believe that

penicillin is much more effective than penicillin, but its value will be dependent to a great extent on the type of organism present. If culture of the bile obtained by choledochostomy reveals *E. coli* strepto

... ..

If the patient is acutely ill and is having numerous chills, extensive preoperative therapy may be necessary to improve operability from

wall of the duct (or gallbladder) It is an expression of obstruction but retains a rather transparent glary appearance until it is infected. When infection develops, it becomes opaque, loses its opalescent appearance and becomes thicker. The appearance of white bile or colorless exudate in the common duct simply indicates that this colorless fluid is being formed at a greater pressure than the formation of bile by the liver. Almost invariably, bile will be found in the intrahepatic ducts, particularly if little time is allowed for secretion of bile to be resumed. This resumption of bile flow can actually be demonstrated on the operating table after the obstruction is relieved. On some occasions, however, it may take twenty four hours or more for the secretory function of the liver to be resumed.

CLINICAL MANIFESTATIONS

1 *Chills and Fever*—The first symptom noted by the patient may be a chill, which of course is associated with fever. As intimated previously, these chills vary greatly in frequency, depending upon the constancy of obstruction and many other factors, including the immunologic response of the patient. However, fever without chills is frequently present. A chill may be an expression of sudden and rather massive bacterial invasion.

2 *Jaundice and Acholic Stools*—Since obstruction is usually present, the patient will have a yellowish discoloration of the skin and sclerae. The stools will be acholic, that is, they will be pale and clay-colored. This is due to the fact that bile is not being secreted into the duodenum. The urine will be dark, due to the presence of urobilinogen. The patient will also have a loss of appetite and may have some nausea and vomiting. The pain in the common duct. This pain may be located either in the epigastrium or right upper quadrant or both. There is not the tendency for it to radiate posteriorly to the tip of the scapula, as noted in pain produced by ordinary gallbladder disease. Perhaps more commonly the pain is located in the epigastrium. If the infection is produced by stricture, pain is variable and, although usually present, it is usually of less intensity. When the condition is caused by carcinoma

physician showed no amebas in the stools. The patient complained of no pain except when jaundiced. Between onset and admission she had three attacks of jaundice, each being associated with fever and abdominal pain. The stools were acholic during these attacks. Her appetite remained fairly good, although she lost 50 pounds during the seven months' period since onset of symptoms. At the time of admission, she stated that diarrhea had disappeared and her stools were formed and of normal color. During the first attack of jaundice, which lasted two or three weeks, a diagnosis of infectious hepatitis was made.

Physical examination upon admission was negative except for a slightly yellow tint to the sclera. There was no abdominal tenderness, no masses were palpable. Laboratory examination revealed erythrocytes 5,100,000, leukocytes 8,900 and hemoglobin 14.5 gm. The urine was negative. Cholecystogram showed no shadow. Proctoscopic examination showed multifocal ulcerations similar to a type of ulcerative or bacillary colitis. Bromsulfalein revealed 30 per cent retention in

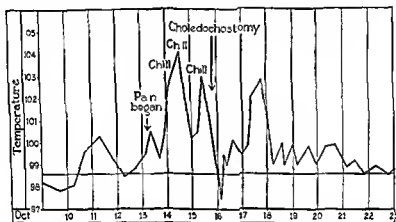


Fig. 10 (Case I) -Cholecholestomy performed for suppurative cholangitis caused by obstructing stone in common duct resulted in prompt recession of fever except for two spikes forty-eight hours after operation. The patient was not jaundiced when admitted October 10, but became jaundiced on the 15th, one day after severe pain in the right upper quadrant developed. Pus was found in the common duct at operation, culture revealed *E. coli* alpha streptococcus and *Staphylococcus aureus*.

thirty minutes, indicating considerable hepatic insufficiency. The stools were formed and were in no way abnormal.

Ten days after admission the patient suddenly developed sharp intermittent precordial pain at 5 A.M. Upon closer questioning at this time she admitted she had had mild attacks of pain similar to this for the past three months. During the next twenty-four hours the pain shifted to the paraumbilical region and finally to the right upper quadrant where it remained. Twenty-four hours after onset of pain the temperature had risen to 102° F with a pulse of 100. Within thirty-six hours of onset of pain she had had two chills and again there was evidence of slight jaundice. The highest temperature was 104° F (Fig. 10). The stool examined forty-eight hours after onset of pain was acholic. The liver enlarged markedly and was palpable six fingerbreadths below the costal margin.

The diagnosis was suppurative cholangitis produced by a stone obstructing the common duct. In view of the chills and high fever, it was thought advisable

the standpoint of safety This is particularly true if nausea and vomit

few exceptions the patient is improved so markedly in two or three
 drainage of the
 if the amount
 quantity of bile
 draining from the duct is as much as 1000 cc or more per day blood
 chloride determinations should be obtained at intervals and extra salt
 given as physiologic saline by vein or subcutaneously

ally the content of the common duct is colorless or grayish in color and
 is purulent However on many occasions (usually in patients with a
 short history of obstruction) there will still be bile in the common duct
 which will usually be streaked with mucopurulent material If there is
 any question about confirmation of the diagnosis a smear of the fluid
 should be made stained and examined microscopically for bacteria

Drainage of the common duct with a T tube is of course necessary
 However attempts should be made to correct the obstruction particu-
 larly if the obstruction is produced by a stone in the common duct
 Under such circumstances the common duct is explored quickly but
 as thoroughly as possible with gallbladder scoops and probes inserted
 upward toward the liver and downward into the duodenum through
 the sphincter of Oddi If the patient is extremely sick confirmation of
 patency of the lower end of the common duct by time consuming
 manipulations will not usually be necessary or justifiable In other
 words the important factor is to save the patient's life If an obstruc-
 tion is entirely out of the question at the time of drainage of the com-
 mon duct

CASE REPORTS

Case I Suppurative Cholangitis Produced by Obstructing Stone in Common Duct

larged, extending three fingerbreadths below the costal margin. There was no tenderness, and no masses palpable other than the enlarged liver. Laboratory examination revealed erythrocytes 3 900 000, leukocytes 13,000, hemoglobin 13 gm. The urine was negative for bile. Icterus index was 37. Total blood proteins were 5.6 gm per 100 cc. A diagnosis of suppurative cholangitis was made. Because of variability in the amount of fever, choledochostomy was not performed until the ninth day after admission to the hospital.

At operation the gallbladder was found to be distended but not thickened and there were no stones in it. The liver was moderately enlarged. There was a small nodular mass about 3 cm. in diameter in the head of the pancreas, but this certainly could not be designated as a malignant tumor. The common duct was aspirated and contained bile which was not purulent. However, the diagnosis of obstruction and cholangitis was so definite that we made a smear for microscopic examination. Numerous gram-negative organisms were found in the smear. This information, we felt, justified draining the common duct. The procedure seemed obviously to have been justified since the temperature and pulse returned immediately to normal and remained so thereafter (Fig. 11).

Convalescence was complicated by an exceedingly large output of bile which was secreted in quantities up to 3000 cc. per day. In spite of particular care relative to intake of sodium chloride on numerous occasions the patient developed severe hypochloremia, we were therefore unable at an early date to get him in satisfactory condition to perform a second laparotomy with the idea of examining the tumor in the head of the pancreas and resecting it if it appeared malignant. Four months later the patient appeared to have improved sufficiently to tolerate a laparotomy but still was a very poor operative risk for a major operation such as resection of the head of the pancreas. Laparotomy was performed and much to our surprise the tumor had enlarged to the size of a tennis ball and numerous metastases were present in the abdomen. It was obviously inoperable. The patient died several months later.

Case III. Suppurative Cholangitis Secondary to Stricture of the Common Duct.

E. A. was a white man, aged 45,* who entered Illinois Research Hospital February 25, 1946, complaining of severe pain in the epigastrium of twenty-four hours' duration. Past history revealed appendectomy in 1929 and cholecystectomy in 1941. At the onset the patient developed fever and pronounced malaise. Pain radiated somewhat to the right upper quadrant. Anorexia was pronounced but he vomited only once.

Physical examination revealed slight tenderness throughout the entire abdomen but more pronounced in the epigastrium. No rigidity was detectable and no masses were noted. The sclerae were slightly yellow. Laboratory examination revealed a normal erythrocytes count, but the leukocyte count was 26,500. The urine was negative. The temperature fluctuated widely between 98° and 105° F. Di-

adhesions were found around the distal portion of the common duct. The gall bladder was missing. Dissection around the common duct revealed a stenosis and a kink produced by adhesions. Dissection of these adhesions from the duct apparently relieved the obstruction. A T tube was placed in the common duct for decompression. The liver was only slightly enlarged and therefore not aspirated. Culture of bile removed at time of operation revealed the presence of *E. coli*. In

It appears quite definite that this patient had one or more small liver abscesses which resolved, but only after streptomycin therapy was instituted. The stricture was not of the type usually encountered in common duct obstruction following operation on the biliary tract, but the clinical picture was identical.

This particular case of stenosis or stricture of the common duct following cholecystitis was chosen to present here because of the patient's failure to respond to choledochostomy (no doubt because of a liver abscess), and his complete recovery following intensive streptomycin therapy.

Case IV. Suppurative Cholangitis Due to Regurgitation of Food Through Choledcho-enterostomy Opening—Followed by Liver Abscess.

F A, a white woman aged 45, who had two or three operations at the Illinois Research Hospital for the repair of a stricture of the common bile duct, which developed immediately after a cholecystectomy performed elsewhere. We performed an operation upon her in March 1943 at which time we found no common duct remaining except a stump at the hilus. We anastomosed the stump of the hepatic duct at the hilus of the liver to a loop of jejunum, making an anastomosis between the two arms of jejunum about 10 inches from the choledchojejunostomy anastomosis. However, we have since learned that this is insufficient to prevent regurgitation of food upward through the isolated segment of jejunum into the common duct. A ray examination of the gastrointestinal tract with barium before the development of acute symptoms in March 1945 showed regurgitation of food up into the liver through the choledchojejunostomy, as it had shown in three other patients upon whom we had performed this type of operation. In spite of this regurgitation the patient remained well from March 1943 until twelve days before her admission to the hospital on April 2, 1945. At that time she had developed chills and fever and jaundice. The jaundice disappeared in about four or five days but the chills and fever continued.

The physical examination was negative except for the fever and slight tenderness in the upper part of the abdomen. The liver was enlarged two fingerbreadths below the costal margin; the diaphragm was not elevated. The blood counts were normal. The urine was negative except for traces of albumin and a faintly positive test for bile. The icterus index was 12.

Our first impression was that the patient had a severe cholangitis but the absence of jaundice and acholic stools did not support this diagnosis strongly, since in the usual case of suppurative cholangitis obstruction of the common duct is always present. The patient was extremely ill, it was obvious that something radical must be done to save her life. Penicillin in large doses seemed to exert no beneficial effect. Since we were quite sure that regurgitation of food through the choledcho-enterostomy would be a possible source of infection we decided upon an emergency operation to interrupt the jejunum proximal to the point of anastomosis.

Accordingly, on April 2, 1945 we performed an emergency laparotomy. The adhesions were extremely dense, requiring sharp dissection. We cut down toward the site of anastomosis and opened into the area representing the junction between the stump of the bile duct and the jejunum. There was no obstruction at this point. We severed the proximal arm of jejunum and turned in both ends, thereby preventing regurgitation. The vitallium tube originally placed at the site

spite of drainage of the common duct and penicillin therapy, the fever did not regress, therefore, on the eighth postoperative day streptomycin therapy was begun and maintained for six days. There was a definite improvement in the patient's

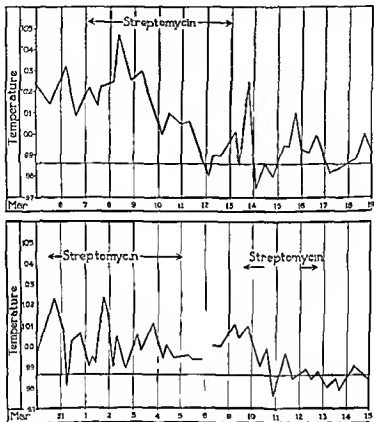


Fig 12 (Case III) —The patient had a choledochostomy to relieve chills, fever, and jaundice. A course of streptomycin was given for 6 days.

choledochostomy had failed. Blood culture at time of operation yielded *E. coli*. Culture of bile from common duct likewise was positive for *E. coli*.

condition following streptomycin but the temperature did not come down to normal (Fig 12). A second course of streptomycin was instituted with favorable results, but a third short course was necessary before the temperature came completely down to normal and remained so.

clinical picture was identical

This particular case of stenosis or stricture of the common duct following cholecystitis was chosen to present here because of the patient's failure to respond to choledochostomy (no doubt because of a liver abscess), and his complete recovery following intensive streptomycin therapy.

Case IV. Suppurative Cholangitis Due to Regurgitation of Food Through Choledocho-enterostomy Opening—Followed by Liver Abscess.

F A A white woman aged 43 who had two or three operations at the Illinois Research Hospital for the repair of a stricture of the common bile duct, which developed immediately after a cholecystectomy performed elsewhere. We performed an operation upon her in March 1943, at which time we found no common duct remaining except a stump at the hilus. We anastomosed the stump of the hepatic duct at the hilus of the liver to a loop of jejunum making an anastomosis between the two arms of jejunum about 10 inches from the choledochojejunostomy anastomosis. However we have since learned that this is insufficient to prevent regurgitation of food upward through the isolated segment of jejunum into the common duct. X ray examination of the gastrointestinal tract with barium before the development of acute symptoms in March 1945 showed regurgitation of food up into the liver through the choledochojejunostomy, as it had shown in three other patients upon whom we had performed this type of operation. In spite of this regurgitation the patient remained well from March 1943 until twelve days before her admission to the hospital on April 2 1945. At that time she had developed chills and fever and jaundice. The jaundice disappeared in about four or five days but the chills and fever continued.

of anastomosis at our operation in 1943 had been passed. We replaced the tube and closed the opening around it. Culture of material obtained from the common bile duct revealed gamma streptococci and bacillus pyocyaneus.

The convalescence was stormy. The patient continued to have chills and fever. The blood culture on April 5, 1945, revealed *E. coli* and *Staphylococcus albus* (Fig. 13). It was now quite obvious that the patient had an abscess (probably multiple) of the liver. (In retrospect it is fairly certain she had it at the time of her emergency operation on April 2, 1945, but the relatively normal size of the liver and negative palpation deterred us from aspiration.) Accordingly, on April 21,

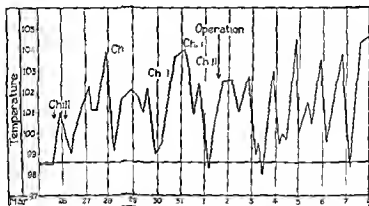


Fig. 13 (Case IV) — Drainage of the common duct in this patient (no obstruction found) was ineffective in controlling fever because of the presence of multiple small liver abscesses as proved three weeks later by autopsy. Note the frequent chills. Penicillin was given throughout the period illustrated and was likewise ineffective. Culture of the bile showed *E. coli* and *Staphylococcus albus*.

condition grew worse and she died April 28, 1945. Autopsy disclosed multiple small liver abscesses.

Summarizing, this patient, who came to us for treatment of a stricture of the common bile duct following cholecystectomy, had a very good result for two years following anastomosis of the stump of common duct at the hilus of the liver to a loop of jejunum, over a vitalium tube. However, at the end of that time, multiple liver abscess developed, with chills and fever. The liver abscesses appear to have been

after the principle of *abscess*

Case V. Suppurative Cholangitis Produced by Carcinoma of the Pancreas.

A. H. was a white man, aged 45, who entered the Illinois Research Hospital September 26, 1944 complaining of jaundice and clay-colored stools beginning three months previously. At the same time he developed diarrhea and had an occasional chill with fever.

One month after onset, the patient went to another hospital, where he had a laparotomy for common duct obstruction. His wife was told that he had a malignant lesion of the head of the pancreas. After operation the jaundice decreased and the stools became normal in color, although on one or two occasions he again became jaundiced for a few days and the stools were acholic. Shortly after

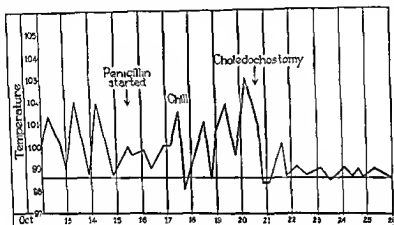


Fig 14 (Case V) —Comparison of value of penicillin and drainage of the common duct with the temperature.

was initiated. Drainage of the common duct resulted in prompt decline of the temperature to normal. The culture of bile obtained at operation was alpha streptococcus.

his operation he developed epigastric pain which increased up to the time of

Examination of the individual jaundiced epigastrum was otherwise was 14,500. The blood protein

The patient was given numerous transfusions and put on penicillin therapy. His temperature occasionally dropped to normal but persisted in having daily excursions up to 101° or 102° F and even higher, although on a few days there was little febrile reaction. Suppurative cholangitis appeared to be the primary cause of the febrile reaction. After many days of observation (Fig 14) it appeared that the infection could not be controlled with penicillin or sulfonamides.

Accordingly, a laparotomy was performed on October 21 1944 and the common duct drained (Fig 14) The common duct which was markedly dilated contained 2 to 3 ounces of purulent fluid After this amount of purulent fluid was obtained bile stained fluid then began to drain from the duct The pancreas itself was enlarged about two or three times was very hard and nodular and appeared

tomy highly improbable

After operation the patient's temperature receded immediately and he was discharged afebrile and much improved Within a few months he developed ascites and definite evidence of metastatic carcinoma and died about a year after the laparotomy

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LABORATORY DIAGNOSIS AND ITS PITFALLS IN THE MANAGEMENT OF "SURGICAL JAUNDICE"

KARL A. MEYER, M D, F A C S,* FREDERICA STEIGMANN, M D, M S,
F A C P† AND HANS POPPER, M D, P H D, F A C P‡

THE indications for surgical intervention in the jaundiced patient were originally based upon the results of physical examination, history and clinical course. Several decades ago liver function tests were introduced as additional diagnostic aids in the difficult differential diagnosis of jaundice. These have helped to establish more clearly criteria for

(among others). However, in these recent studies most of the emphasis was laid upon the medical rather than the surgical type of icterus.

In civilian practice the most important problem in the management of jaundiced patients is still the differentiation between hepatitis, including cirrhosis (medical jaundice) on the one hand and extrahepatic biliary obstruction (surgical jaundice) due to tumor, scar and stone,

was based upon the concept that in "medical jaundice" impairment of liver function occurs, whereas in "surgical jaundice" the liver functions are almost entirely normal or only slightly impaired. This assumption has been variously modified in recent years but it can still serve as an important basis in the differential diagnosis of jaundice. The literal application of this concept would mean that patients with significantly impaired liver function should not be operated upon, whereas patients with normal liver function would benefit from surgical relief of the obstruction which caused the jaundice. In practice, however, this concept had to be subjected to extensive qualifications and modifications,

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much more so in recent years, in view of improved knowledge of liver physiology, as well as on the basis of clinical and pathological experiences

A part of the improvement of our knowledge of liver physiology is the better understanding of the bile pigment metabolism, as a result of recently developed reliable laboratory methods for its study. Another part is the better understanding of the varied functions of the liver cells per se. It thus appears timely to take stock of the present facilities for the diagnosis of surgical jaundice and to emphasize especially the aid of modern laboratory methods in this diagnosis. In this paper, therefore, we shall discuss first the application of the different laboratory procedures* in the differential diagnosis and management of jaundice from the point of view of (1) differentiation of extrahepatic biliary obstruction from that due to intrahepatic changes, (2) analysis of the nature of the obstruction and (3) alarm signals indicating liver breakdown. This will be followed by discussion of three common pitfalls in the diagnosis of jaundice which may occur if clinical and laboratory findings are not correlated.

1. ENUMERATION OF LABORATORY TESTS USED IN THE DIFFERENTIAL DIAGNOSIS OF "SURGICAL JAUNDICE"

The two factors to be established in the differential diagnosis of surgical jaundice are (A) impairment of bile flow, (B) impairment of liver function.

A. Impairment of Bile Flow.—1. *Absence of Urobilinogen from the*

reaction in the urine. In using the semiquantitative method of Watson^{7,8} less than 1 Ehrlich unit in an afternoon two hour sample of

alkaline phosphatase, which in alkaline medium splits organic phosphorus compounds to phosphate is formed by the osteoblasts as part of the process of calcium phosphate deposition in bone. The enzyme is excreted through the bile and interference with biliary excretion leads to an increase in the serum phosphatase level (over 4 Bodansky units).⁹ Recent evidence suggests that other factors are involved in this mechanism, such as production of phosphatase in the damaged liver.

* References will be given only to the more recently developed procedures.

cells due to hyperstimulation^{10 11} However, for the time being, high serum phosphatase is considered primarily as evidence of extra biliary obstruction, while a slight to moderate rise may occur in hepatitis

3 *Hypercholesteremia*—Since cholesterol is excreted in the bile, interference with the bile flow leads to increase in the blood cholesterol level (Significant if over 300 mg per 100 cc in the method used)¹²

B *Evidence of Dysfunction of the Liver Cells*—1 *Quantitative Changes in the Total Amount and the Ratio of the Blood Proteins*—Since the liver plays a main role in the production of serum protein, liver damage leads to a reduction of the serum protein level, often far below 6 per cent the lower limit of the normal Since many other factors especially malnutrition, produce a similar condition the differential diagnostic value of hypoproteinemia as evidence of liver damage, is limited Of more diagnostic value is the reduction of the albumin fraction This plus the occasional increase of the globulin fraction leads to a reduction of the normal albumin globulin ratio of 2:1, often even to a complete reversal of the ratio This latter phenomenon is more specific for impaired liver function than the decrease of the total serum protein It however, occurs sometimes only as a late manifestation and its value in the diagnosis of surgical conditions is therefore not too great

2 *Qualitative Changes of the Plasma Protein*—In exact physico-chemical studies by means of the ultracentrifuge, the following

the alpha, beta and gamma globulins, the latter being larger molecules than the first two In liver cell damage, the gamma globulins are increased in amount and the alpha and beta globulins are decreased

(a) *Thymol Turbidity Test*—This test is used clinically to detect liver damage It becomes positive (3+ and 4+) in liver damage of moderate to severe degree

(b) *the thymol turbidity test* In liver damage, this test reveals more than 4 units turbidity^{15 16} It becomes positive somewhat later than the other tests and also persists for a longer period¹⁷ The mechanism of the test is still unknown but it seems to depend upon the interference of the gamma globulin with the light beam

3 *Cholesterol Esters*—Since the liver plays a predominant part in the esterification of the free cholesterol, the percentage of cholesterol esters is usually below 50 per cent in liver cell damage

4 *Changes in Prothrombin Time*—The prothrombin may be reduced in jaundice either due to insufficient absorption of vitamin K

from the intestinal tract because of the absence of bile salts from the intestine (obstructive jaundice) or due to inability of the liver to form prothrombin (hepatitis jaundice). In noncomplicated obstructive jaundice, medication with vitamin K restores the prothrombin time permanently to normal, whereas, in liver damage vitamin K increases the

puric acid is excreted in the presence of parenchymal liver damage.¹⁹

6 *Urobilinogenuria*—The reoxidation of urobilinogen to bilirubin by the liver cells is interfered with in relatively mild degrees of liver damage. In such instances a larger fraction of urobilinogen than otherwise is excreted in the urine and therefore the increased urobilinogen excretion (more than 25 units in the semiquantitative method of Watson in two-hour samples) is a sign of liver cell involvement if a hemolytic process can be excluded by other means.

7 *Renal Pathology*—In hepatitis parenchymal damage in the kidney changes, if

Function and Bile Flow.—1 *Serum Bilirubin*—Elevation of the serum bilirubin level may be due to either retention of bilirubin in the blood because of increased supply to the liver as a result of increased blood destruction (hemobilirubin), or due to regurgitation of bilirubin which had already passed through the liver cells from the bile capillaries into the blood stream (cholebilirubin). The hemobilirubin is connected with plasma protein and therefore fails to give the direct van den Bergh reaction or to appear in the urine. The cholebilirubin gives the direct reaction and appears in the urine.

Regurgitation jaundice manifested by the presence of direct bilirubin in blood and by bilirubinuria may be the result of both liver cell damage, i.e. break up of the liver cell cords or of extrahepatic biliary obstruction which has caused dilatation and rupture of the bile capillaries. Of differential diagnostic significance is only the observation

level is above 3 mg per 100 cc also points to a liver cell injury.

2 *Bilirubinuria*—As discussed above the presence of bilirubin in the urine (as demonstrated by one of the older methods or by the

than 6 per cent after forty five minutes if 5 mg per kilogram are

given) in jaundice may be due either to inability of the liver to excrete

discussed here

D Liver Biopsy—In recent years the histologic examination of liver biopsy specimens obtained either by needle puncture³ or by peritoneoscopy has been carried out on a wide scale. In the opinion of some investigators³ the histologic picture permits the differentiation between extrahepatic obstructive lesions and primary hepatitis. In the

the lesion are obtained by the biopsy. Obscure conditions associated with hepatomegaly have been clarified by this method. Moreover the results of therapy can also be followed by it. Although in the majority of cases the differentiation between acute primary hepatitis and biliary hepatitis due to extrahepatic obstruction was possible in some instances wrong conclusions were reached on the basis of the histologic picture alone. This fact seems to limit the value of liver biopsy in the diagnosis of surgical jaundice.

II. NATURE OF OBSTRUCTION

Laboratory methods will be of only limited aid in establishing the cause of the extrahepatic biliary obstruction. The greatest help may be obtained from a serial follow up of the urinary urobilinogen excretion. Since stones in the majority of instances will produce an incomplete obstruction often of changing degree the bilirubin excretion into the intestine will vary quite markedly. Because periods of retention may alternate with those of free flow of bile there results an actual compensatory increase in the amount of bile reaching the intestine during the latter periods. Moreover since secondary liver cell damage may also be present markedly reduced urinary urobilinogen levels may alternate with greatly increased levels in the two periods respectively. In contrast to the above malignant obstruction will decrease progressively the bile flow into the intestine and the urinary urobilinogen levels drop thus to almost zero during the course of the disease.^{24, 25}

In the majority of cases of obstructive jaundice whether due to tumor or stone the sedimentation rate is higher than in medical jaundice. The white count, too, will be of only limited value although it is usually elevated in surgical types of jaundice. Anemia obviously will point more to a malignant than a benign obstruction.

* Studies in cooperation with Donald D. Kozoll who is performing the aspirations.

III ALARM SIGNALS

In some cases of well established extrahepatic biliary obstruction it may appear advantageous to postpone surgical intervention until a more thorough diagnostic work up has been done or until the patient has been well prepared for surgery. In such cases there may occur at times a sudden breakdown of the function of the liver parenchyma which may lead to a rapid deterioration of the patient's condition. Then, immediate surgery, even at greater risk, may be indicated to save the patient's life. In these cases we rely on the following results of laboratory tests as alarm signals:

A A sudden rise of a formerly constant bilirubin level during un- complicated obstruction. In uncomplicated obstructive jaundice, a balance between urinary excretion and retention stabilizes the plasma bilirubin at a certain level. Additional liver damage raises it far above

case. In our experience this alarming rise of nonprotein nitrogen level was far more commonly observed in secondary biliary hepatitis due to sustained obstruction than in primary liver damage as for example in infectious hepatitis.

D The appearance of free tyrosine in the urine as recognized by Millon's reaction.* The follow up of this simple qualitative urinary reaction in cases of obstructive jaundice during the observation period has helped to detect imminent liver cell breakdown.

COMMON PITFALLS IN THE LABORATORY DIAGNOSIS OF "SURGICAL JAUNDICE"

over the boundaries usually drawn between medical and surgical jaundice. They are: (1) Intrahepatic obstruction in hepatitis (2) second- ary extrahepatic obstruction. In the latter group of cases the laboratory diagnosis is often hampered by hema- togenous infection. From the point of view of labora-

* Millon's Reagent. One part of metallic mercury is dissolved in two parts of nitric acid (specific gravity 1.42) by gradual heating. After the mercury has dissolved two parts of water are added.

ties show the laboratory findings of a medical jaundice although the underlying cause is a surgical condition

1 **Intrahepatic Biliary Obstruction in Hepatitis**—During the course of acute hepatitis, infectious or toxic, and in some cases also during the active stage of cirrhosis the bile flow into the duodenum may be almost completely interrupted for various lengths of time although no mechanical obstruction can be demonstrated anywhere in the extrahepatic biliary passages. The anatomical basis of this phenomenon of intrahepatic biliary obstruction has so far not been completely explained. Inflammatory processes in the portal fields leading to compression or amputation of the smallest terminal bile ducts have been considered as the cause for this interruption of the bile flow.^{20 21} Recently Watson and Hofbauer considered a pathologic permeability of those bile ducts as the cause of the phenomenon.²² Peculiarly enough, in quite a number of these cases of intrahepatic biliary obstruction, damage of the epithelial liver cells may be absent or only present to a small degree.²³ In some instances, especially in certain cases of neoarsphenamine hepatitis, intrahepatic biliary obstruction with a normal extrahepatic biliary tract is present apparently from the beginning, and the present laboratory findings are solely those of an obstruction to the bile flow.^{24 25} In other instances, after an initial period of liver cell damage with decreased bile flow a prolonged period may follow in which the jaundice is solely due to intrahepatic biliary obstruction.²⁶ Whatever the significance of this phenomenon may be, it is of great disturbance to the attending clinician because of the similarity to extrahepatic biliary obstruction which can be relieved surgically. Quite a number of patients manifesting such a phenomenon come to operation because of the uneasy feeling on the part of the clinician that a stone may be overlooked. As an example of such a condition the following case is presented

CASE 1—H M, a 42 - - -
the Cook County Hospital

tiredness after slight effort
She had been well until
sided pain in her back
and vomiting after meals

The illness began
patient's job was
away from work
her job and was
until three months
low and she was

" - - - - - my stools were quite dark

intermittently
" - - - - - darker and
constipation

- - - - - a sensation of tiredness. These

III. ALARM SIGNALS

In some cases of well established extrahepatic biliary obstruction it may appear advantageous to postpone surgical intervention until a more thorough diagnostic work up has been done or until the patient has been well prepared for surgery. In such cases there may occur at times a sudden breakdown of the function of the liver parenchyma which may lead to a rapid deterioration of the patient's condition. Then, immediate surgery, even at greater risk, may be indicated to save the patient's life. In these cases we rely on the following results of laboratory tests as alarm signals:

A *A sudden rise of a formerly constant bilirubin level during un complicated obstruction.* In uncomplicated obstructive jaundice, a balance between urinary excretion and retention stabilizes the plasma bilirubin at a certain level. Additional liver damage raises it far above

B *Inadequate response to vitamin K therapy.* Appearance of signs

of obstructive jaundice is an indication of secondary severe liver and renal disease. In our experience this alarming rise of nonprotein nitrogen level was far more commonly observed in secondary biliary hepatitis due to sustained obstruction than in primary liver damage as, for example, in infectious hepatitis.

D *The appearance of free tyrosine in the urine as recognized by Millon's reaction.** The follow up of this simple qualitative urinary reaction in cases of obstructive jaundice during the observation period has helped to detect imminent liver cell breakdown.

COMMON PITFALLS IN THE LABORATORY DIAGNOSIS OF "SURGICAL JAUNDICE"

primary biliary hepatitis due to prolonged obstruction of the extrahepatic biliary passages and (3) purulent infection of the portal tracts of the

* Millon's Reagent. One part of metallic mercury is dissolved in two parts of nitric acid (specific gravity 1.42) by gradual heating. After the mercury has dissolved two parts of water are added.

Obviously, surgical intervention is not indicated in primary hepatitis with intrahepatic biliary obstruction. The existence of this condition may be suspected, first, if evidence exists that the period of liver cell damage has preceded that of the obstruction, this can be learned only where the opportunity exists to observe the entire course of the dis-

who have undergone operation have died because of the surgical interference. This has been noted from published reports and in our own material. On the contrary, improvement of the intrahepatic biliary obstruction was frequently seen despite such unwarranted operations. In view of the present well developed technic of preoperative preparation, serious untoward results from surgical intervention are rather rare and thus the fear of overlooking an extrahepatic biliary obstruction may at times outweigh any contraindications to surgery.

2 Secondary Biliary Hepatitis.—In extrahepatic obstruction of the biliary passages a secondary liver cell damage appears relatively early which is the result of retention of injurious bile products within the liver cells and the bile capillaries. The injurious substance is probably not in the bile pigments but in the bile acids. This secondary biliary hepatitis as we like to call it is in many ways similar to a toxic hepatitis of other

different
from the functional
changes resulting from obstruction
and develop faster and more extensively in complete than in incomplete obstruction
varies greatly
complete obstruction
to completely

the primary toxic or infectious hepatitis. At this time the differential diagnosis by liver function test between medical and surgical jaundice will be possible only if no liver function damage is encountered. After complete obstruction for six weeks, severe liver function damage is invariably present, and quite often the picture of fully developed cholemia may present itself. In incomplete obstruction obviously the time intervals are longer and less clearly defined depending upon the degree of obstruction. As a whole, the conclusion is justified that the differential diagnosis between extrahepatic biliary obstruction and primary liver cell damage will be possible only in the earlier stages of jaundice. Moreover in jaundice of longer duration (three weeks or more) more reliance should be placed on the less sensitive liver function tests than on the sensitive ones, which at this time may be positive due to beginning biliary hepatitis. In this situation we like to rely especially on the hippuric acid test, on the response to vitamin K ther-

symptoms again necessitated her quitting her job. At home her symptoms became worse and finally made her enter the hospital.

She denied any exposure to hepatotoxic substances or infectious diseases but stated that she drank liberal quantities of wine for the past few years. In 1943 she was operated for fibroids and suffered an attack of arthritis in the same year. Following this she felt well until this present illness. There was a 20 pound weight loss in the past few months.

The physical examination revealed a well developed and well nourished colored female. The heart was normal. The lungs were clear. The abdomen was soft and nontender. The liver was enlarged to about five fingerbreadths below the costal margin. It was smooth, firm, nontender. The spleen was suggestively palpable. There was no edema of the lower extremities. Pelvic examination was negative.

Routine laboratory examination on entrance revealed the urine to contain 1 plus albumin, 4 plus bilirubin, but no urobilinogen. The hemoglobin was 49 per cent, red blood count 3,070,000, white blood count 15,000 with 84 polymorphonuclears, 10 lymphocytes, 5 monocytes and 1 basophil. The blood smear showed a macrocytosis. Examination of the stools showed 4 plus blood by the benzidine test. The Kahn test was negative. The icterus index was 171. An electrocardiogram showed slight myocardial damage.

A preliminary diagnosis of cirrhosis with jaundice, or carcinoma of the extrahepatic bile ducts, was made. The patient was put on an intensive liver regimen: high protein, high vitamin, high carbohydrate, high caloric, low fat diet with

rubin with 148 mg. or 45 per cent of the direct type. The cephalin cholesterol flocculation was 3 plus, the prothrombin time 80 per cent of normal and the sedimentation rate 29 mm. per hour. The hippuric acid excretion (intravenous method) was only 9 per cent. The urinary urobilinogen was 2.18 mg. per twenty-four hours and the fecal urobilinogen 27.36 mg. per 100 gm. of stool. A flat x-ray film of the abdomen was positive for a calcific shadow in the region of the gallbladder.

gestive of cirrhosis.

Exploration was done three weeks after the patient's admission to the hospital. The liver was enlarged to about five fingerbreadths below the costal margin. It was smooth, firm, nontender. The spleen was suggestively palpable. There was no edema of the lower extremities. Pelvic examination was negative.

was shown by the reversal of the albumin globulin ratio, the low cholesterol esters and the decreased hippuric acid excretion

The above findings, suggesting obstruction are not necessarily absolute indications of a surgical jaundice because, as pointed out earlier, obstructive phenomenon may occur in hepatitis. However, because of this patient's prolonged icterus (seven weeks duration) it was thought that the liver damage was secondary to the prolonged extrahepatic obstruction and the patient was therefore operated upon. At operation the clinical opinion was confirmed by the findings.

3 Purulent Hepatitis—Infection of the intrahepatic biliary passages or the portal fields by pyogenic microorganisms interferes markedly with the liver function apparently by spread of the toxic effect from the portal fields to the lobular parenchyma. This is commonly considered the result of an ascending infection of the bile ducts due to partial or complete obstruction interfering with the physiologic cleansing of the bile passages by the bile current. The possibility of hematogenous (portal vein) or lymphogenous infection of the portal fields—as from a cholecystitis or infection of the common or cystic ducts—is at present not fully established. Anyway the possibility exists that in surgical jaundice due to the extrahepatic biliary obstruction a secondary liver cell damage purulent in character, may confuse the picture by imitating a primary toxic or infectious hepatitis. Fever, chills, leukocytosis and marked elevation of the sedimentation rate may help in differentiating this purulent hepatitis, which may complicate the extrahepatic biliary obstruction at any time of its course. It is therefore not necessarily as late a complication as the biliary hepatitis. Its occurrence is an urgent indication for surgical intervention. A typical example of such a condition is discussed in the following.

CASE III R. R. a 48 year old white man was admitted to the hospital with the history of selective dyspepsia to fried fatty foods for many years. Two years prior he had three attacks of epigastric pain associated with nausea and vomiting. These occurred following some dietary indiscretion. Since then he went week ago he ate some meat developed severe pain in the g (two times). The vomiting day he noted that his skin
his urine darker than

124 mm of mercury systolic and 74 mm diastolic. The findings in the chest, lungs and heart were all negative. The abdomen was rounded. Respiration 24 and blood pressure

apy, and to a certain degree on the cephalin-cholesterol flocculation test. In the following a representative case is discussed.

noted that his abdomen was becoming distended and that he had bleeding from

His past history and family history were irrelevant.

The physical examination revealed a fairly well developed and fairly well nourished white man who was deeply icteric with a greenish hue to his skin. His blood pressure was 150 mm of mercury systolic and 100 mm diastolic, his pulse 88. There were signs of weight loss. There were no findings of significance in his chest. The abdomen was slightly distended but there was no fluid. The liver was four fingers below the right costal margin, smooth and somewhat tender upon pressure. The gallbladder and spleen were not felt. The extremities were negative except for areas of dermatitis factitia from scratching due to the severe pruritus.

no urobilin
white blood
lymphocytes
The icterus

Further liver function tests revealed a sedimentation rate of 35 mm per hour

bilinogen in twenty-four hours and the fecal urobilinogen was 3.74 mg per 100 gm. The intravenous hippuric acid test showed a 30 per cent excretion of the injected material.

After a short period of observation on the medical service the patient was transferred to a surgical ward for operation. On exploration a malignant tumor of the head of the pancreas was found; the liver was markedly enlarged and the gallbladder distended. No evidence of metastasis was noted. A cholecystogastrotomy was performed.

This patient presented on laboratory examination both findings of obstruction and of liver damage. The obstruction was indicated by the high alkaline phosphatase, the absence of cephalin-cholesterol flocculation and the very low urinary and fecal urobilinogen. Liver damage

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and urobilinogen. The white blood count was 30,400 with 76 per cent polymorphonuclears. The Wassermann reaction of the gallbladder failed. Scout film. Liver function tests: free cholesterol 400 mg/100 ml, albumin 3.83, globulin 3.07.

Because of the patient's history, findings and septic course on the ward a diagnosis of cholelithiasis with possible empyema was made and surgery was advised. At operation the liver was found enlarged and of brownish red color. The gallbladder was under the liver edge and covered by omentum. It contained bile and some pus. Drainage of the gallbladder was instituted and the abdomen closed. The patient made an uneventful recovery.

About three weeks after operation a recheck examination revealed a cholesterol ester ratio of 31 per cent and an albumin globulin ratio of 4.62/2.79. The icterus index had dropped to 30.

In this case the finding of poor liver function pointed to hepatitis but the clinical findings were predominantly those of a surgical lesion with infection and the timely surgical intervention probably saved this man. In this patient there was impairment of liver function pointing to a hepatitis. However because of the clinical findings the diagnosis of infection was made and confirmed at operation.

SUMMARY AND CONCLUSIONS

The laboratory procedures which aid in the diagnosis of surgical jaundice are presented and their indications and limitations are discussed. Special emphasis is laid upon the pitfalls in the diagnosis of surgical jaundice which may result from depending solely upon the results of liver function tests. These pitfalls are demonstrated by the presentation of clinical case histories which portray particularly three important conditions which may confuse the diagnosis of surgical jaundice. These three conditions are (1) intrahepatic biliary obstruction during the course of a primary hepatitis—infectious or toxic—or cirrhosis which may mimic an extrahepatic biliary obstruction to such an extent that an operation is performed, (2) biliary hepatitis and (3) purulent

function tests alone.

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INTESTINAL OBSTRUCTION

Analysis of 352 Cases

WILLIAM HENDRICKS, M D * AND WILLIAM D GRIFFIN, M D †

THE problem of intestinal obstruction presents one very important source of difficulty in that there are no absolute criteria to differentiate simple and strangulating obstructions. The features of bowel obstruction are similar to many acute abdominal disorders. It is necessary to rely on accurate histories, physical examinations and laboratory data in the diagnosis.

about 50 per cent of all obstructions, they are not included in this series because they do not present the same problem in diagnosis as do cases of internal obstruction.

The primary features of small and large bowel obstruction in 352 cases have been analyzed together with the mortality and morbidity statistics. The procedures that in our experience have lowered the mortality rate are given in detail.

SMALL BOWEL OBSTRUCTION

168 Cases

Obstruction of the small intestine may be divided into two main types: high small bowel obstruction and low small bowel obstruction. High small bowel obstruction is characterized by profuse emesis and loss of fluids. Low small bowel obstruction is characterized by more marked distention and severe local effects on the obstructed bowel.

High small bowel obstruction constituted 10.6 per cent of the cases in this series. These lesions were characterized by sharp colicky upper abdominal pain, profuse emesis, marked dehydration and early prostration. Emesis was copious from the start and progressive. The patient was dehydrated and there was loss of fluids and electrolytes. There was scanty urine passed. The plasma protein sometimes rose, there was an increase in the blood urea and nonprotein nitrogen. These patients responded well to intravenous fluids and intestinal decompression by suction with the Miller-Abbott and Levin tubes. Distention

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The particular differential diagnosis involved in the examination of the patient is not within the scope of this study. Although incarcerated and strangulated external hernias (an additional 139 cases) constitute about 50 per cent of all obstructions, they are not included in this series because they do not present the same problem in diagnosis as do cases of internal obstruction.

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TABLE 2—PATHOLOGY, SYMPTOMS AND MORTALITY OF SMALL BOWEL OBSTRUCTION
Total Cases 168

Location	Type of Obstruction	Predominant Symptoms	Bowel Reactions	Mortality
Jejunum 10.5% Ileum, 59.4%	Adhesions 58% Intussusception 17% Volvulus 9.1% Gallstones 8% Tumors and strictures 3.5% Meckel's diverticula 2.9% Internal hernias 2.3%	Abdominal colic 85% Recurrent emesis 80% Distention 71% Typical history 82.9% Temperature above 100°F. 61% Absolute leukocytosis 56% Previous abdominal surgery 57% Diagnostic roentgenograms 83%	Total resections End to-end anastomosis 59% Side-to-side anastomosis 21% Exteriorization with resection 17%	Total mortality, 27.9% Bowel resection mortality End to-end 20% Side-to-side, 41% Exteriorization with resection 50%

was minimal and constipation was comparatively late in the course of the disease.

Low small bowel obstruction, a much more common lesion, was located in the terminal ileum in 89.4 per cent of our cases.

Table 1 lists the cause of obstruction in the following frequency adhesions, 58 per cent, intussusception, 17 per cent, children, twenty five cases, adults, four cases, volvulus, 9 per cent, gallstones, 98 per cent, Meckel's diverticulum, 29 per cent, tumors, atresias, tuberculosis



Fig 15 --Duodenal obstruction due to atresia in a newborn Patient had profuse regurgitant emesis with distended epigastrium

ad loc. 25 nov 1961 ad atom 11. 20

the group pain vomiting and distention

The pain in intestinal obstruction was described as a colic that was abrupt in onset in 85 per cent of our cases and located about the umbilicus in 54 per cent. Between the bouts of colic the patients sometimes had complete relief. The colic was synchronous with borborygmi, either audible to the patient or apparent on auscultation. Visible peristalsis was infrequent, being present in only 15 per cent of the

cases. The bowel sounds were described as high pitched, gurgling rushes in 60 per cent. It is the occurrence of colic with borborygmus that differentiates the colic of obstruction from the colic of other intra-abdominal lesions. Late in the course of the disease colicky pain and obstructive peristaltic sounds may be absent as a result of the distention and paralysis of the bowel.

The vomiting of obstruction may be described as a persistent, re-gurgitant emesis that fails to relieve the pain. An emesis of this type



Fig. 16—Flat film of abdomen in gallstone obturation obstruction. Gallbladder visualized as distended with air was the clue to the diagnosis.

occurred in 80 per cent of our cases. Ten per cent had feculent emesis on admission, this group of neglected cases has a grave prognosis.

Distention in a complete low small bowel obstruction occurs with pain and emesis and was an admission symptom in 74 per cent of cases. The distention was asymmetrical, being confined to the lower abdomen in the great majority of cases. When the duodenum was obstructed, the epigastrium was filled with the distended stomach (Fig. 15). When the lower ileum is involved the distention is usually confined to the lower abdomen. The distention is often more real than apparent. The abdomen must be carefully measured to detect it. We consider a normal abdomen to be scaphoid and below the level of the

xiphopubic line with the patient in the supine position. When the abdominal contour extends above the xiphopubic line, distention of some degree is present. The repeated measurement of the abdominal girth at the umbilicus with a steel tape is used to record the distention and its progress.

Constipation is an unreliable symptom of small bowel obstruction. Only 18.5 per cent of our patients complained of obstipation. Some patients were constipated for many days and showed no signs or sym-



Fig. 17—Flat film of abdomen showing calcified gallstone in terminal ileum at the level of the second sacral segment.

toms of intestinal obstruction. It is the usual practice to give an enema to determine if the patient can pass feces or flatus. The supposition is that if the patient can pass feces or flatus, there is no obstruction. For obstruction (Figs. 16 and 17), we recovered mineral oil in the enema. The oil had been previously given by mouth. Many of these patients had markedly necrotic and ulcerative loops of bowel at laparotomy.

Among the 100 cases of small bowel obstruction, 100

perature above 100° F. Fifty-six per cent showed leukocytosis on admission. As the obstruction continues unrelieved, the patient becomes prostrate by his illness, markedly dehydrated, with cold and clammy skin and weak pulse. In strangulating obstructions shock was present, the abdomen was silent, tender, rigid and distended. Strangulation usually occurs unless the distention of the bowel is relieved without delay.

The x ray examination by means of a scout film with the patient in the supine position was diagnostic of obstruction in 65 per cent of the cases and was a great aid in the determination of the type and the



Fig. 18—Small bowel obstruction showing laddering, parallelism and herring bone pattern of the bowel.

location of the obstruction (Fig. 18). Visible gas in distended loops of small bowel is absolutely diagnostic of stasis of the intestinal contents. Comparison of repeated films, taken at intervals of twelve hours or less, helps to determine the degree of distention and the effects of decompression procedures. As the gas patterns of mechanical small bowel obstruction and paralytic ileus are quite similar in some cases, differentiation must be made with the stethoscope (Fig. 19). In the presence of strangulation and peritonitis a paralytic ileus is superimposed upon a mechanical obstruction and treatment must be directed to the cause.

Illustrative Case—The following case has been chosen because it illustrates the predominant symptoms and signs of acute low small bowel obstruction

A 35 year old white woman was perfectly well until thirty six hours before admission. Thirty six hours previously she noticed a sudden cramping abdominal pain that doubled her up, lasted about three minutes and then ceased completely. The pain returned in a few minutes, associated with nausea, the pain was now moderate in force and located periumbilically. The pain continued intermittently, recurring at about ten minute intervals but of increasing intensity. The patient was comfortable between seizures. Twelve hours after the onset the patient



Fig. 19—Paralytic ileus showing typical appearance of mechanical small bowel obstruction

noticed that her abdomen was beginning to swell and the nausea was now associated with a regurgitant emesis that did not relieve the pain. The patient slept fitfully that night, her sleep being disturbed because of pain and emesis. Twenty hours after the onset the patient had persistent, regurgitant emesis, persistent abdominal colic and abdominal distention. The patient had not passed flatus in twelve hours.

The past history was negative except for occasional mild attacks of indigestion and a feeling of abdominal fullness. These attacks subsided on home medication. The patient had a supracervical hysterectomy four years ago.

tense but not tender. Peristaltic sounds were high pitched with tinkles interspersed, and occurred at three-minute intervals. Rectal examination was negative. Temperature was 100° F., respiration 21, pulse 92, blood pressure 140/80, hemoglobin 90 per cent, erythrocytes 5 300 000, urinary specific gravity 1.025. The flat plate of the abdomen revealed moderate distention of the small bowel. The patient was treated conservatively with the use of a Levin tube, Wangensteen suction and intravenous fluids. After four hours of conservative treatment the abdominal distention had not decreased, the temperature had risen to 101.2° F. and the abdomen was tender in both the right and left lower quadrants. Peristaltic sounds were diminished. A repeat flat film of the abdomen showed an incision in the distention of the small bowel.

The abdomen was opened through a right paramedian incision and the terminal ileum was adherent to the cervical stump and obstructed by scar tissue with a superimposed volvulus of the small bowel. The twisted loop was distended



Fig. 20—Ileo ileal intussusception treated by primary resection and end-to-end anastomosis.

and gangrenous. The adhesion was separated. A resection of the gangrenous seg-

fection. The patient was discharged on the tenth postoperative day.

for 58 per cent of the obstructing lesions of the small bowel. Twenty-seven patients (16 per cent) had had previous attacks and recovered on conservative treatment. A total of twelve patients had previous

operations for small bowel obstruction In thirty six cases, the previous surgical procedure performed was an appendectomy (21 per cent) In thirty one cases (18.4 per cent) the patient had a laparotomy for some gynecological condition A total of ninety six patients had previous surgery of some type Fifty seven per cent of the adhesive obstructions resulted from previous operative trauma The presence of a scarred abdomen with obstructive manifestations indicates the diagnosis of adhesive obstruction in the majority of patients

The ileum was involved twelve times more frequently than the jejunum Gangrene of the ileum was found in thirty cases and gangrene of the jejunum in four cases Tuberculosis of the small bowel

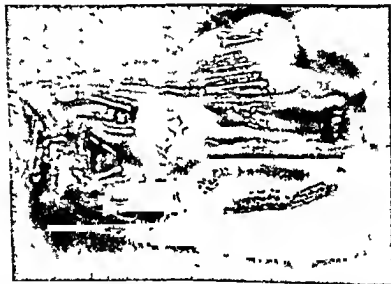


Fig 21 -Resected specimen Pathological report fibrolipoma

with obstruction fibrolipoma with ileo ileal intussusception (Figs 20 and 21) carcinoid tumor scirrhus carcinoma, capillary hemangioma each one case and regional enteritis two cases Hernias of the internal type were found in four cases and ileocecal intussusception in all stages in thirty two cases There were two atresias of the small bowel one of the ileum and one of the jejunum

Treatment -Treatment in general consisted of the immediate use of the Miller Abbott and the Levin tube with Wangenstein suction and the judicious use of sodium sulfadiazine penicillin intravenous fluids and blood transfusions to restore fluid loss and normal renal function in preparation for expectant surgery Eighty seven of our patients were ill forty-eight hours before treatment fifty seven patients

were untreated from two to five days before admission and in twenty four patients the attacks of colic had existed from five to twenty-one days before they came to the hospital. Six patients died a few hours after admission.

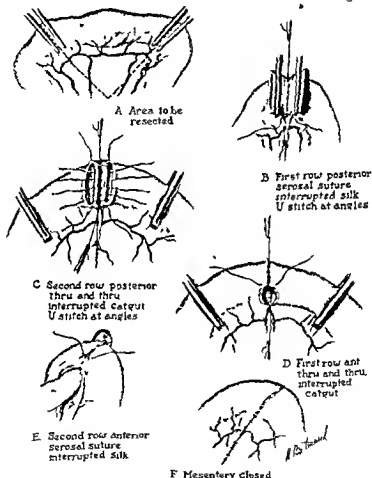


Fig 22—End to-end anastomosis using interrupted technique throughout

at a ~~thorough~~ in our total group could only be examinations. If the distention was ; with a return of normal peristaltic is continued and twenty patients

were relieved of obstruction by conservative means. If however the temperature or pulse continued to increase the abdomen became tender or peristalsis ceased the patient was immediately decompressed by surgical means. Disastrous interference with intestinal viability may become apparent within the comparatively short interval of one hour

ment was then determined by the condition of the bowel and the condition of the patient.

Emergency laparotomy was performed in 142 cases. The surgical procedure instituted at laparotomy depended on the condition of the bowel and the condition of the patient. In 98 per cent of the cases we were able to correct the cause of the obstruction itself without resorting to enterostomy. Severance of adhesions was performed in 43 per cent alone and in conjunction with some other surgery in 15 per cent. Bowel resection of all types was performed in 34 per cent of all operative cases. 83 per cent of these resections were end to end and side to side anastomoses. End to end anastomosis of a simplified type (Fig 22) was performed in 59 per cent of the resected cases, side to side anastomosis being used when the marked difference in luminal diameter made an end to end anastomosis impossible. Ileostomy for removal of gallstones with or without resection was performed in 9.8 per cent of the total cases. Reduction of intussusception with or without resection in 13 per cent and detorsion of volvulus with widening of the mesentery in 11 per cent. Meckel's diverticula were removed in 3.5 per cent and internal hernias were found in association with obstruction in 2.8 per cent of instances.

Postoperative therapy consisted of sulfadiazine, penicillin, supportive treatment of the patient and intestinal decompression by suction until intestinal motility returned.

Results—In small bowel obstruction our over all surgical mortality was 27.9 per cent. Forty patients died following surgery. In all forty six patients died and 122 recovered. Of the forty six patients who died six were in a terminal stage on admission and died within a few hours without surgery. Thirteen patients or 9.1 per cent died in shock within twelve hours of surgery in spite of therapy. Twenty seven per cent of the patients who died had perforation and peritonitis at the time of surgery and 18 per cent of the patients who died had peritonitis after surgery or a total of 45 per cent with peritonitis.

Twenty-one or 45 per cent of the patients who died were over 50 years of age. A total of 78 per cent had persistent emesis that was controlled only by suction and 30 per cent of these had feculent emesis. Distention was severe on admission in 80 per cent of the cases. Abdominal tenderness and rebound tenderness was present in 58 per cent

with absent peristaltic sounds in 15 per cent. The temperature was over 100° F. in 73 per cent with a leukocytosis in 64 per cent. The bowel sounds were indicative of high grade obstruction in 65 per cent. There was x ray evidence of obstruction in 58 per cent and the terminal ileum was involved in 89.4 per cent of the cases.

It is apparent from the above figures that the mortality was increased by a delay on the part of the patient in seeking treatment. The duration of the symptoms at home before coming to the hospital was two days in seventy-one instances, from two to five days in sixty-three instances and there were thirty-four cases in which the duration of pain existed from five to twenty-one days. In all 168 cases, the average duration of the patient's hospital stay before surgery was instituted was from two to twelve hours, in more than 60 per cent of the 142 cases that were operated upon. Other factors that influenced the mortality were obstructions difficult to deal with in patients with poor cardiac reserve, old age and its infirmities, great distentions and strangulating obstructions.

LARGE BOWEL OBSTRUCTION

184 Cases

Large bowel obstructions differ widely from small bowel obstructions in that 90 per cent of them are simple obstructions to the luminal continuity of the bowel due to carcinoma, and 10 per cent of them are divided between volvulus, intussusception, pelvic inflammatory conditions and, rarely, adhesions. The symptomatology, however, is quite similar to that of small bowel obstruction, differing only in the time

1.

then decreases and ceases as abruptly as it began. The patient is comfortable between pains. The colic is frequent when an acute obstruction occurs. When the obstruction continues unrelieved over a long period of time or when vascular or nerve damage to the bowel is super-

nostic of a bowel obstructed and distended with fluid and gas

flanks. In the distended abdomen peristaltic waves are rarely visible and their presence indicates only that an acute obstruction has been superimposed upon a chronic obstruction of the colon.

A history of constipation of a chronic nature that has progressed to an obstipation is usually elicited. These patients are chronic takers of cathartics who may show periodicity of constipation and diarrhea, passage of blood or mucus and meteorism. The complaint of constipation



Fig. 23—Barium enema showing an obstructing carcinoma of the sigmoid colon. The markedly dilated colon proximal to the lesion is easily visible.

may appear early or late in the sequence of the history depending on whether the obstruction is near the cecum or the rectum.

Vomiting is a later and usually preterminal symptom of large bowel obstruction in that the cecal valvula is competent and the contents cannot pass (cent).

Emesis

imposed small bowel obstruction, an incompetent ileocecal valve, or an adynamic ileus due to peritonitis.

The symptoms of large bowel obstruction may be summarized by the picture of a symmetrical distention of a high grade, not accom-

panied by nausea or vomiting but accompanied by intestinal colic and constipation

The *physical findings* of large bowel obstruction are meager considering the seriousness of the lesion. The abdomen is distended but the patient is comfortable. No peristaltic waves are visible. The abdomen is tympanitic and tense, but not rigid or tender. The presence of tenderness indicates that the viability of the bowel has been impaired and, when present over the cecum indicates the immediate danger of spontaneous perforation.



Fig. 24—Incomplete sigmoid volvulus showing ball valve action at the site of twist

The blood changes in large bowel obstruction are minimal and usually consist of a leukocytosis. There is a marked elevation of the sedimentation rate.

A flat plate of the abdomen with the patient in the supine position must be obtained. The abdomen may be distended and tender.

may not always be evident on examination of the flat plate of the abdomen. Further evidence in a cooperative patient may be obtained by

use of a tap water enema. If the patient can take and retain 2000 cc of enema, the obstruction should be considered proximal to the hepatic flexure. Barium enema (Fig 23) will not be necessary for diagnosis in the majority of cases but, when used, will adequately outline the site of obstruction, except when the obstruction is in the rectum, and there

the obstruction

Illustrative Case—The following case is cited as representative of large bowel obstruction

J J, a 74 year old male Negro was an ambulant patient who was admitted to the hospital with the following complaints. He stated that eighty six hours previously he noticed cramping abdominal pain moderate in force and located suprapubically in the lower abdomen. He took some mineral oil for relief. The pain however continued intermittently for about four hours and then stopped. This pain then recurred in two hours and spread throughout the entire lower abdomen of the same nature as previously but of stronger intensity recurring about every twenty to thirty minutes and lasting about two minutes. About five hours after the onset the patient noticed that his abdomen was beginning to swell. Twenty four hours after the onset the patient passed a small amount of flatus which relieved him for a few hours. Home remedies consisting of mineral oil and enemas produced no relief. The patient stated that he was unable to hold the enema. The past history was negative except for a chronic constipation for the past five years alternating with diarrhea for the past six months. He had never noticed any blood on or in his stools. He had lost ten pounds in the last six months although his appetite had remained good.

The patient did not appear acutely ill. There was marked abdominal distention that was symmetrical. Peristaltic waves were not visible. The abdomen was tense but not rigid with tenderness on palpation over the cecal region. Peristaltic sounds were high pitched with tinkles and rushes and occurred every two minutes. The rectal examination was negative and there was no gross or chemical blood. The temperature was 99.2° F, respiration 21, pulse 86, blood pressure 158/85, the urinary specific gravity was 1.025, the hemoglobin 67 per cent and the erythrocyte count 4,000,000. The patient was unable to take more than 750 cc of tap water enema and it returned clear. The barium enema revealed a

From Table 2 it is apparent that obstruction of the left half of the colon is eight times more frequent than in the right half of the colon. The type of obstruction that is usually seen is a simple obstruction of the luminal continuity of the bowel without peritonitis. The strangulated type of obstruction in which the blood supply is comprised with peritonitis will be seen in the sigmoid colon and cecum. The ileocecal junction is the site of obstruction for in carcinoma.

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Fig. 24.—Incomplete sigmoid volvulus showing ball valve action at the site of twist

The blood changes in large bowel obstruction are minimal and usually consist of a secondary anemia. The average erythrocyte count was

be taken to include the diaphragm and the pelvis and is diagnostic showing the marked distention of the cecum and colon proximal to the obstruction and the normal empty bowel distal to the obstruction.

The location of the exact *site of the obstruction* in the large bowel may not always be evident on examination of the flat plate of the abdomen. Further evidence in a cooperative patient may be obtained by

Treatment—The treatment of colonic obstructions is primarily surgical, for simple obstructions are closed loop obstructions that cannot be decompressed with intestinal intubation and suction of the non

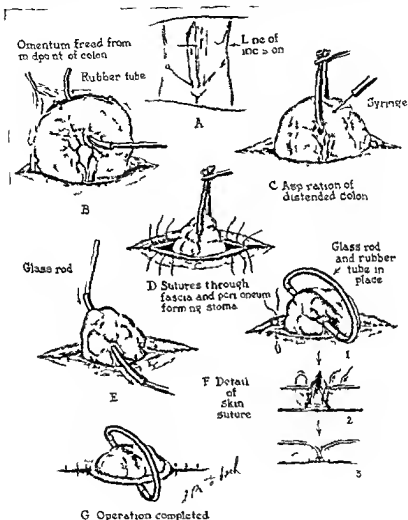


Fig. 25—Transverse colostomy

operative type. It is only in the very unusual cases that the ileocecal valve is grossly incompetent and cecal contents may be discharged into the terminal ileum and decompressed by suction. The conservative routine of oil by mouth and enema may be tried but should not be

TABLE 2—DISTRIBUTION, PATHOLOGY AND MORTALITY IN COLONIC OBSTRUCTION
184 Cases, 1910-1915

Site of Lesion	No. of Cases	Percentage of Cases	Pathology	Mortality
Cecum	12	6.5	Carcinoma, 10 Volvulus, 2	1910-14 135 cases
Ascending colon	8	4.5	Carcinoma, 8	10 deaths 44.6%
Hepatic Flexure	6	3.2	Carcinoma, 6	1915 49 cases
Transverse colon	8	4.5	Carcinoma 8	10 deaths 20.5%
Splenic flexure	16	91.0	Carcinoma, 16	1916 21 cases
Descending colon	8	4.5	Carcinoma 7 Sarcoma, 1	5 deaths 23.3%
Sigmoid and rectum	110	60.9	Carcinoma, 98 Adhesions, 1 Volvulus, 10	1910-1915 47 cases
Left colon	150	80.9	Carcinoma 140 93.3% Volvulus, 10-6 7.7%	Transverse colectomy, 21%
Right colon	34	19.1	Carcinoma, 31 Volvulus, 2	Cecostomy, 10.5%

Treatment.—The treatment of colonic obstructions is primarily surgical, for simple obstructions are closed loop obstructions that cannot be decompressed with intestinal intubation and suction of the non

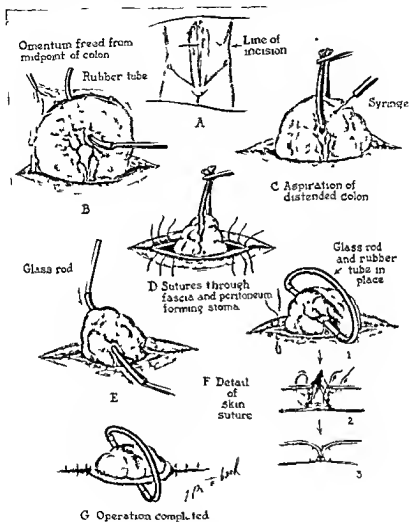


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Left colon	150	80.9	Carcinoma 110-93 3.3% Volvulus, 10-6 7%	Transverse colectomy, 21%
Right colon	31	19.1	Carcinoma, 31 Volvulus, 2	Cecostomy, 40.5%

and the fact that no sutures are placed into the distended bowel or mesentery. The bowel may be opened in twenty four to forty eight hours with cautery for permanent decompression.

LESIONS OF RIGHT HALF OF COLON—Lesions of the right half of the colon must be decompressed early in the course of the disease because a rupture of the cecum may occur in these cases with only a small amount of apparent distention. The surgical procedure of choice in these cases is the McNealy cecostomy. We consider the following to be the indications for cecostomy:

- 1 Lesions in the proximal one half of the colon
- 2 Patients who have tremendous distentions with impending perforation where the site of the lesion has not been determined and where the patient's condition will not tolerate more than the simplest procedure under a local anæsthesia.

There is usually a choice of two anesthetics, spinal and local. Spinal anesthesia is ideal because the muscular relaxation afforded permits the surgeon to work with the greatest facility. It should not be used when the patient is profoundly toxic when he is markedly anemic or

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secutive cases of emergency colonic decompressions were done with a mortality rate of 44.5 per cent. In 1944 we began to employ transverse colostomies whenever possible. In 1945 there was a total of forty nine cases of colonic obstruction with a total mortality of 20.5 per cent. Thirty nine of these cases were carcinoma. In the thirty nine cases twenty four cecostomies were done with a mortality of 29 per cent, fifteen transverse colostomies with a mortality of 6.6 per cent and ten Mikulicz procedures with a mortality of 20 per cent. From 1940 to 1945 inclusive forty seven transverse colostomies were performed with a 21 per cent mortality and 142 cecostomies with a mortality of 40.5 per cent. We were thus able to lower our mortality from 44.6 to 20.5 per cent apparently by the use of a transverse colostomy. We are convinced however that the employment of transverse colostomy was only one of the factors which affected the mortality rate so markedly. Other important factors are early differential diagnosis of large from small bowel obstruction and surgical decompression without delay when conservative methods are ineffectual. We therefore concentrated on these factors:

- 1 Early diagnosis
- 2 Early decompression
- 3 Adequate preparation of the patient for surgery
- 4 The use of spinal and local anesthesia
- 5 The use of the transverse colostomy for lesions of the left half of

persisted in without careful and repeated examinations of the patient for a measurable decrease in distention and the passage of gas per rectum. The abdomen should be repeatedly examined for evidence of cecal tenderness and impending perforation. Conservative treatment should consist of preparation of the patient for surgery, the uses of intravenous infusion for dehydration and, as blood changes are a significant factor in volvulus, intussusception and strangulated bowel, the judicious use of whole blood transfusions may be required.

In the discussion of the surgical decompression of colonic obstruction, the right and left halves

cinoma, a direct attack against the offending lesion is contraindicated, for the mortality of an operation for carcinoma is doubled in the presence of obstruction.

LESIONS OF LEFT HALF OF COLON—For lesions of the left half of the colon we advise a transverse colostomy of a simplified type. The transverse colon is chosen because it is an easily localized thick-walled loop of bowel with little danger of spontaneous perforation on handling. It is proximal to the site of obstruction and will permit adequate decompression of both the left and right segments of the bowel and diversion of the fecal stream for subsequent surgery. Also it conserves body fluids and electrolytes at a time when they are at a dangerously low level. Subsequently, it is much more desirable because of the semisolid homogeneous character of the discharge from the colostomy loop.

Technic of Transverse Colostomy—The technic of transverse colostomy as used by the authors is as follows:

A transverse incision (Fig. 25) is placed through the right rectus muscle, midway between the umbilicus and the xiphoid process so that the colostomy will be out of the field of subsequent surgery. The

ends brought together and clamped. When the transverse colon is promi-

wire, No. 31 stainless steel to 3 inches is left. The skin is approximated about the bowel with interrupted silk. A rubber tube is threaded over the glass tube for $\frac{1}{2}$ inch and the glass tube is drawn under the bowel. The distinct advantages of this method are the removal of the obstructed and distended bowel from the field of surgery when closing the abdomen, the ease and facility of repairs and adjustments on the stoma in the abdomen.

opacity comes to a sharp point and produces the appearance of an "ace of spades" (Fig 26) that is simulated by no other intra abdominal lesion. Then, from the examination of the flat x ray films of the abdomen and, in doubtful cases, of the films following the barium enema, the diagnosis of sigmoid volvulus may be made with a reasonable degree of assurance.



Fig 26 -Sigmoid volvulus showing typical pattern of distal sigmoid

Two of the patients in this series had gangrene of the sigmoid loop and one of these died with a generalized peritonitis. The mortality rate for ten cases of sigmoid volvulus was 20 per cent. The other mortality factor was cardiac failure.

All these patients were treated by exteriorization and second stage resection.

SUMMARY AND CONCLUSIONS

An analysis of 352 cases of bowel obstruction has been presented, of which 168 cases were small bowel obstruction and 184 cases were

the colon and the use of the cecostomy for lesions of the right half of the colon

twelve cases of transverse colostomy and nine cases of cecostomy with the same mortality rate. In our experience, the cause of death continues to be infection. The common causes of death in large bowel surgery is, in the following order: peritonitis, bronchopneumonia and circulatory failure. For both our cecostomies and transverse colostomies, the cause of death was in that order.

SIGMOID VOLVULUS

of strangulation and perforation

Volvulus of the sigmoid colon is of two types. The acute type is characterized by occurrence in the younger age groups, of short onset with an equivocal history of constipation, early transient emesis, generalized cramping abdominal pain, abdominal tenderness, acute distention and marked prostration. These patients tend to develop gangrene early and

disease. These patients tended to develop gangrene late in the course of the disease and run a more moderate course.

The symptomatology of sigmoid volvulus of the subacute type is quite typical. The majority of patients were ambulant despite their tremendous distention. Attacks of partial obstruction of the colon are followed by a complete obstruction. The abdomen is tremendously

distended that shows the tremendously dilated sigmoid by moving the entire abdomen. The barium enema reveals a normal mucosal pattern in the sigmoid and rectum distal to the dilated loop. The upper end of the

BOWEL OBSTRUCTION IN THE NEWBORN

EDWIN M. MILLER M.D.*

It is my purpose in the clinic this morning to discuss with you briefly a subject which for many years has been of great interest to me namely bowel obstruction in the newborn infant. It has been of special interest to me as a surgeon because in the last analysis relief from obstruction is usually obtained only by operative measures and it should be of special interest to you gentlemen who are general practitioners or pediatricians because you have the opportunity of seeing these patients very early and the outcome will often depend in great measure upon the thoroughness of your initial examination your observation of the baby during the first few days of life and your judgment in deciding upon the proper course to pursue.

I think it is fair to state that when a newborn infant manifests clinically the signs of a partial or complete obstruction of the gastrointestinal tract there is a strong probability that some type of congenital developmental defect is present and I believe that the statement made by Bland Sutton over sixty years ago is true viz that such defects are most apt to occur at the sites where the embryological processes are the most complex and therefore the chances of error the greatest namely (1) in the esophagus at about the level of the bifurcation of the trachea (2) in the duodenum close to the ampulla of the Vater (3) in the lower ileum in the neighborhood of Meckel's diverticulum and (4) in the lower rectum and anus. Obviously it would be impossible here in so short a time to speak of all of the almost innumerable possibilities that might be met with so I shall confine my remarks to those which are the most common and endeavor to illustrate with a typical example of each.

CONGENITAL ATRESIA OF THE ESOPHAGUS

It is a frequent occurrence as you well know for normal babies to spit up or regurgitate some of their food and ordinarily it is of no consequence but when the newborn infant immediately after delivery starts

will be evidenced in which an attempt is made to pass a catheter into the stomach the tube fails to descend more than a few centimeters

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vomiting and distention were the outstanding symptoms and were present in 80 per cent of the cases

Early diagnosis and early surgical decompression in small bowel obstruction have been emphasized Enterostomy was necessary in only two cases In 98 per cent of the cases the cause of the obstruction was corrected directly

Resection was performed in 34 per cent of our cases

An over all mortality rate of 27.9 per cent is reported

Carcinoma was the cause in 90 per cent of the cases of large bowel obstruction The left side of the colon was involved in 81 per cent and the right side of the colon in 19 per cent of the cases

A transverse colostomy is the operation of choice when the lesion is in the left half and a cecostomy when the lesion is in the right half of the colon

A mortality rate of 20.5 per cent is reported

milestone in the long continued search for a solution of this tough problem and I cannot urge upon you too strongly that you carefully study their original publication.* You will find there related some of their early failures, a detailed description of their operative technic the selection of cases for operation, and the pre and postoperative care. This work has been a stimulus to surgeons in many other clinics



Fig 2"—R W aged 1 week Congenital atresia of the esophagus with a blind upper segment and communication between the trachea and the lower segment which leads directly into the stomach. Gastrostomy performed 10/4/20. Death nine days later. X ray film after introducing Lipiodol through gastrostomy tube.

and reports of successful operation have since come from Lanman, Lam, Gross and others. In the transactions of the American Surgical Association for 1944, Haight⁷ again reviews the entire subject and reports six successful results in the sixteen infants in whom the primary

* Haight C and Towsley H A. Congenital Atresia of the Esophagus with Tracheo-esophageal Fistula. Extrapleural Ligation of Fistula and End-to-End Anastomosis of Esophageal Segments. Surg. Gynec. & Obst., 76:672 (June) 1943.

In our experience, which covers a series of eleven cases, we have had seven successful results, and the following technic has proved satisfactory. The abdomen is opened through a right rectus incision, under either local or general anesthesia, and the liver is retracted to the right, thus exposing the duodenum which in one of our cases was almost as large as the stomach. One identifies the position of the colon, determines the presence or absence of a volvulus, and carefully looks for any abnormal bands. This procedure may involve complete exposure



Fig. 2A Infant M, aged 51 days, weight 24 pounds. Congenital atresia of the duodenum. Obstructed duodenum visualized after introducing barium through a tube in the stomach.

of all of the loops of bowel and several minutes may be consumed before the exact site and nature of the *obstructing mechanism* are made clear. Any constricting band is cut across and a volvulus is untwisted, but if an atresia is apparently *present*, or a high grade stenosis exists (it may be difficult to distinguish between the two especially if the point of obstruction lies hidden beneath the root of the mesentery) nothing but a short-circuiting anastomosis will be of any avail. Furthermore it is our belief that when the site of involvement is low

anastomosis was attempted. Thus it is evident that the future in this field is not completely dark, but rather much is to be hoped for in selected cases.

CONGENITAL ATRESIA OF THE DUODENUM

The problem of congenital obstruction of the duodenum is rapidly becoming more encouraging, because successful results following surgery are more frequently being reported. Until thirty years ago the literature on the subject was an uninterrupted series of autopsy descriptions and the pathology was well understood, but it was not until 1916 that Ernst, a Copenhagen surgeon, published the first success by operation. Two types of lesions are recognized: (1) the intrinsic, consisting either of a tight narrowing of the lumen (stenosis), usually at or near the ampulla of Vater, or a complete interruption of the continuity of the channel (atresia), and occasionally an iris-like diaphragm such as depicted by Seidlin,⁹ and Morton and Jones¹⁰; (2) the extrinsic variety is due to some pathology outside the bowel wall, such as a congenital band (Jackson),¹¹ pressure from overlying mesenteric vessels, and very commonly, as pointed out in the numerous writings of Prof W. E. Ladd¹² of Boston and E. J. Donovan and R. McIntosh¹³ of New York, a twist or volvulus of the midgut on the axis of the superior mesenteric artery, associated with nonrotation, incomplete rotation, or reversed rotation (clockwise) of the large bowel. Whatever the cause may be, the clinical picture is quite unique, and if the infant is carefully observed the condition should be easily recognized by the attending physician. Vomiting, of course, is the chief symptom, and, unlike that associated with congenital pyloric stenosis, it begins almost immediately after birth, is progressive, persistent and almost always continues. The diagnosis is usually made by roentgen-ray examination of the stomach and duodenum can be clearly visualized and no

come in a case of congenital obstruction of the duodenum demands early diagnosis and immediate accurate surgical intervention. Infants fortunate enough to have only a stenosis may live for days, months, or perhaps years in fair health; those with an atresia die, if unrelieved, within a few days. It is well to keep in mind that during the hours of preparation for operation the use of a Levin tube in the stomach and the administration of adequate fluids by vein (as well as small amounts of blood) will contribute much to the ease of the procedure and the smoothness of the postoperative course.



Fig 29—Infant C 1/13/42 aged 5 days Atresia of the lower ileum Before operation—successful outcome following anastomosis X ray film showing distended loops of small bowel



Fig 30—Meconium ileus X ray film showing distended loops of small bowel in an infant a few days old

enough to produce biliary vomiting and has caused a marked dilatation of the duodenum, an anastomosis between the wide duodenum and the collapsed ribbon like first loop of jejunum (usually antecolic because of the narrow space in the mesentery of the transverse colon between the right and middle colic arteries) is without doubt the procedure of choice, whereas if the obstruction is high in the duodenum (as in one of our earliest cases) and has not been associated with bile in the vomitus it calls for a gastroenterostomy. The technic of anastomosis is naturally difficult because of the minuteness of the structures (the collapsed jejunum being about the size of a goose quill), but with care two rows of the finest sutures can be accurately placed, and a water tight anastomosis completed.

It is perhaps needless to mention but extremely important to emphasize that the most painstaking and meticulous postoperative care on the part of the surgeon and all others concerned is necessary if a successful operative result is to be obtained.

CONGENITAL ATRESIA OF THE ILEUM

In contrast to complete obstruction of the duodenum, atresia of the

lum of Meckel and there (as in the duodenum or esophagus) may be found a complete gap in the continuity of the bowel (as in our first successful case) or a narrowing tight enough to block the lumen effectively. The clinical picture here as when the duodenum is involved is quite unique but by way of contrast let me emphasize that the vomiting which in either is the chief symptom begins immediately after birth is at first composed of stomach contents then is stained with bile and rapidly becomes brown in color and has a fetid odor. The lower abdomen instead of being relatively flat (as with duodenal atresia) becomes progressively distended and throughout a tympanic note on percussion is found. The roentgen findings here are also of great importance the plain film (Fig. 29) showing clearly the loops of distended small bowel and no air can be seen in the colon. Moreover if a little barium be introduced by enema the collapsed state of the large bowel is readily made out.

In making the diagnosis I would insert here a word of caution to wit, that a similar picture may be produced by a *meconium ileus* a condition for which operation affords little or no relief. We are here indebted particularly to Dr. Sidney Farber¹⁴ pathologist at Harvard University who has pointed out in his several writings on this subject that the dry rubberlike inspissated bowel content in a baby with *meconium ileus* (which is due primarily to a dysfunction of the pan-

fact, nothing but a wide exposure of the site of obstruction and a short-circuiting anastomosis offers the slightest chance of recovery. The accompanying drawing made by the artist at the operating table well illustrates the steps of the technic which we have employed in our two successful cases in one of which a gap of more than an inch existed between the dilated proximal bowel and the small distal collapsed loop (Fig 31)

OBSTRUCTION DUE TO MALFORMATIONS OF THE LOWER RECTUM AND ANAL ORIFICES

Any discussion of bowel obstruction in the newborn could be far from complete if no mention were made of the most frequent cause, namely, malformations of the lower rectum and anus. Here again we see the importance of careful examination at the time of birth, for if an imperforate anus be present it can at once be detected, and if a fistula exists between the blind rectum and the vagina, urethra or perineum the passage of meconium through the abnormal opening gives one an immediate clue as to the type of pathologic deviation that may be present. In this field as in so many others having to do with surgery in infants and children, we owe a great deal to Prof Wm E. Ladd of Boston, who for many years was chief of service at the Children's Hospital and has only recently retired from this position to confine his work to private practice. If you will carefully read the book written by Dr Ladd and his associate Dr Robert Gross, published in 1941 and entitled "Abdominal Surgery of Infancy and Childhood" you will find not only an exhaustive discussion of this field of

cases, diagnosis and the treatment in each.

Group I An opening is present at the anal orifice, but it may be small and may be associated with a narrowing of the lumen of the terminal rectum perhaps 1 to 4 inches above the orifice. Naturally, medical advice is sought for these patients later than for those with no opening at all and several months may have passed before they are brought to the surgeon. They have had difficulty in moving the bowels and have become quite dependent on the use of enemas.

On examination one finds an in (often only a few millimeters in rectum is felt with the examining finger. The treatment involves a crucial incision if the opening is small, followed by graded dilatations until the channel is permanently normal in size. If a vaginal or perineal fistula is also present which opens quite low down, the tract may be dissected out, divided, and the rectum brought down far enough to exteriorize the opening of the fistula.

creas) may completely block the lumen and lead to a fatal termination (Fig 30)

Treatment—By way of treatment it must be apparent to everyone that nothing short of prompt surgical intervention will be of any avail. Left alone for more than two or three days the rapidly distending com



Fig 31—D B aged 4 days Congenital atresia of the lower ileum showing the steps in the operative technique which resulted favorably A Right rectus in

pletely obstructed bowel undergoes progressive degenerative changes

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Ladd classifies the malformations of lower rectum and anus into four

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Group II The anus is imperforate and the blind rectum lies close beneath the anal membrane (Fig 32 A) The abnormality is of course, easily seen by the obstetrician attending pediatrician, parents or the nurse and no meconium is passed onto the diaper There may be a bluish discoloration underneath the thin membrane, and when the infant cries an impulse may be felt The signs of complete obstruction develop fast and within a day or two there is vomiting and abdominal distention There is obviously need for immediate relief, which is easily obtained by crucial invasion followed by daily dilatation

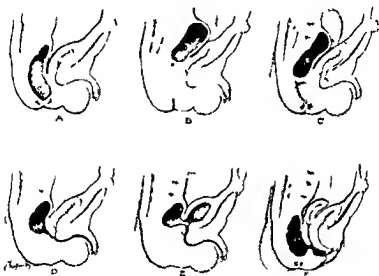


Fig 32 -Drawings illustrating the most common types of congenital malformations about the lower rectum and anus

Group III The anus is imperforate but the blind pouch of rectum

fistula opening into the vagina (Fig 32 I) or into the perineum present a probe passed through it may give one a clue which will aid

down, the distance between the base of the rectum pouch and the

marker can be readily determined by x ray (Fig 33). Naturally the treatment will depend upon the evidence thus obtained and also upon the presence or absence of a fistula. A pouch which lies less than 2 cm from the surface can be brought down through the anal sphincter (after thorough mobilization) which is divided in the midline. If the pouch lies high, 3 cm or more in the pelvis, a life-saving sigmoid colostomy should be done, and further operative work considered later. Fistulas communicating with the bladder or urethra (Fig 32 E, D) are best left



Fig 33—Infant K, aged 54 hours. Imperforate anus. Wangenstein test with x ray of infant in inverted position aids in determining the position of the blind rectal pouch.

alone (after colostomy) until the increase in size of the parts makes these difficult operations easier.

Group IV The anus and distal part of the rectum are normal, and the blind rectal pouch lies high in the pelvis (Fig 32, C). Unfortunately the normal appearance of the anal orifice and the patency of the lower rectum are often misleading and considerable time may have passed before the cause of the complete obstruction is accurately determined. Colostomy, of course, is here the only choice and if the baby survives this procedure there is ample time to decide whether a union of the blind pouch and the lower segment can be safely done.

In conclusion, I wish to emphasize that the subject which we have here so briefly outlined is of extreme importance and worthy of your careful consideration, because you men who are in the field, so to speak, have such an important part in it to play, and upon your shoulders therefore rests a great responsibility.

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ACUTE ABDOMINAL SURGERY WITH SPECIAL REFERENCE TO BOWEL OBSTRUCTION AND A NOTE ON CHRONIC APPENDICITIS OBLITERANS

HUGH MCKENNA, M D, F A C S *

EXPERIENCE in the treatment of acute bowel obstruction has led me to the conclusion that the management should be based upon two

However, I have found that many of the extreme cases even in the hands of experienced surgeons terminate fatally because of the attempt to complete the entire operation in one stage. A good example of the stage type of operation is the following case

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CASE 1—Mr M P entered St Joseph's Hospital on August 19 1946 at 7 00 P M. He gave a history of an acute severe generalized abdominal pain beginning that morning at 7 30 o'clock following breakfast. In the late afternoon he called a physician who sent him to the hospital. The patient was nauseated and had

After a thorough examination and consultation with an internist the doctor decided to await further developments inasmuch as there was no increase in the temperature or in the leukocyte count

impressions and the result of the x ray examination led me to make a diagnosis of volvulus and the patient was operated upon immediately

Operation and Subsequent Course—Administration of intravenous fluids including plasma was begun before the patient entered the operating room. A median incision was made between the umbilicus

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and symphysis. The only viscus appearing in the field was the small intestine which seemed to fill the entire lower abdomen and to be completely gangrenous. I decided at once to do a quick two stage operation. The gangrenous bowel measuring over 6 feet in length was drawn out of the wound. With the bowel covered with hot fomentations the healthy upper ileum was drawn over to the lower ileum approximately 8 inches beyond the gangrenous part and near the ileocecal valve and a lateral anastomosis was rapidly made. The anesthetist continued to report a rapidly lowering blood pressure in spite of the fact that the patient was getting plasma. Whole blood was ordered the administration of which fortunately was begun at the conclusion of the operation when the blood pressure had fallen to 45/30. The ileum was twisted around itself because of an adhesion between the omentum and the mesentery of the bowel. This black loop of bowel presented a perfect textbook picture of volvulus.

Owing to the patient's poor physical condition the wound was rapidly closed around the protruding small intestine a few sutures securing the small bowel so that the anastomosis was well within the abdomen. A large dressing was applied covering the gangrenous bowel and the patient was returned to his room where he was given a second

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On the following morning the surgical supervisor brought equipment to the room and there a rapid resection of the gangrenous intestine and mesentery was made and a carefully prepared surgical dressing applied. No attempt was made to close the two ends of the resected bowel one reason being that the open bowel provides a means for decompression of the small intestine. Moreover I did not wish to subject the patient to any further operative procedure at this time as his blood pressure began to lower quite rapidly and he began to go into shock. Under the stimulus of whole blood plasma and other intravenous medications the patient progressed to a recovery. Within four days of the operation his bowels began to move normally although

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When the patient had been out of bed for a week he was discharged from the hospital on September 22, 1946 and returned to his home where he was instructed to carry out his dressings until the wound had healed sufficiently to permit a surgical closure if it becomes necessary.

I have seen these intestinal fistulas close automatically and in that event the closure of a postincisional hernia is easily made. On September 28, 1946 the patient returned to the outpatient department as instructed, walking in without difficulty. He stated that he was feeling splendid, that practically all feces was being evacuated normally and the wound was granulating rapidly. Only a small fistulous opening was present, through which but little bowel content was passing. As a result, the irritation of the skin from the pancreatic secretion was markedly lessened.

STRANGULATED HERNIA

in the right inguinal region. He returned home where urination gave no relief. There was no nausea, vomiting or epigastric pain. The patient's wife called me at 5 o'clock, asking me to stop in on my way home. She was not urgent about the time, she stated, however, that her husband had had a right inguinal hernia and she thought there was a possibility that it had strangulated. I went immediately to the home. The patient was lying on a couch, his face as white as the bed sheet.

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Operation and Subsequent Course—Because of the large amount of fat in the region of the inguinal canal ethylene gas rather than local infiltration anesthesia was chosen in order to expedite the operation. On cutting down over the external ring I found a heavy rigid band of fibrous tissue which made the incision somewhat difficult because of the close connection to the hernial content. The omentum, which was partially incarcerated, was reduced whereupon the small bowel came back freely, finally exposing approximately 7 inches of gangrenous bowel. To make certain that the circulation of the gangrenous

at this time the bowel was changed so its resection was considered necessary. The bowel was resected, the ends closed, and a lateral anastomosis made. No attempt was made to place the bowel isoperistaltic for the reason that in these cases the mesentery is always

tenic defect is much more easily closed and, by preventing the escape

of a loop of small bowel through this defect, the blood supply is less disturbed than if the anastomosis had been made isoperistaltic. A formal repair of the hernial sac was not attempted.

The patient made good progress in recovery for five days, at which time he experienced some fever and abdominal distention, although his bowels had moved satisfactorily for a few days postoperatively. No difficulty in the abdomen was apparent. The patient had complained the day before of stiffness in his neck. A nasal tube had been in use since the operation. On examination hyperemia of the posterior portion of the left side of the palate was noted, and a peritonsillar abscess was diagnosed. A throat consultant was called, who made two large, fairly deep incisions anterior and posterior to the tonsil but did not find pus. On the following day, however, the pus began to flow quite freely and the patient continued to improve. This improvement lasted only a few days when the patient became very ill and a medical colleague diagnosed acute hemorrhagic nephritis.

I am giving this postoperative history in some detail because of the extreme character of the complications in a patient who finally recovered. Much laboratory investigation was carried out in this case, but I will cite only the reports on the nonprotein nitrogen of the blood which on August 12, 1946, reached 278 mg per 100 cc, and creatinine which on the same date was 9.5 mg. These are the highest figures I have ever observed in a patient who recovered. I will not burden you with the details of the medical treatment. Suffice it to say that the modern drugs, penicillin and sulfonamides were used. The patient was discharged from the hospital on August 26 and is making a slow but satisfactory recovery.

RUPTURED APPENDIX

CASE III—Miss B. R. entered the hospital on February 21, 1946, relating that early in the evening of the previous day she began to have lower abdominal pain. The

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the lower right quadrant. Within an hour the condition had advanced to a point where I was satisfied that the patient had a diseased appendix with possible abscess formation and that the possibility of inflammation of the pelvis was remote. An exploratory operation was agreed upon. The patient was taken to the operating room and a right rectus incision made. A large ruptured appendix was exposed and removed. The patient made a prompt recovery.

My purpose in reporting this case is to emphasize that whenever an acute condition develops in the abdomen the appendix should always be kept in mind as the possible offender.

APPENDICITIS OBLITERANS

In the last part of the last century Dr. Nicholas Senn reported on a number of cases of appendicitis obliterans. Through the years since reading this well written article and paying much attention to the subject of appendicitis I am sometimes disturbed because of the profession's position or rather lack of information respecting appendicitis obliterans. Primrose wrote a detailed description of the nerve supply to the appendix. This is extremely interesting in connection with this subject. The obliteration of the lumen begins as a rule in the terminal part of the appendix and continues back to the cecum. In the complete case the lumen is entirely obliterated and nothing but a fibrous cord remains. A neurologic type of pain constant and recurring accompanies the obliterating of the lumen but the frank symptoms of appendicitis namely fever and leukocytosis are absent. Many of these patients suffer with pain not severely for a long period of life and finally come to the conclusion that they have a malignant condition. I am at this time reporting two of these patients one of whom left the hospital two days ago.

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After deciding against an operation I called an associate who agreed that the condition was not surgical. It was interesting on entering the patient's room the next morning to see her with her hands drawn over her breast and the fingers in the characteristic contracture of tetany. This was about as fine a lesson as I have been able to give to residents and interns on the differential diagnosis of the acute abdomen. The case proved to be one of vitamin C, D and B deficiency.

heretofore not been separately described for a number of years, I have noticed in the examination of specimens removed from cases of recurring appendicitis, varying degrees of contraction of the lumen of

STAGE OPERATIONS IN ACUTE ABDOMINAL EMERGENCIES

In this clinic I have referred to stage operations in certain of the critically ill patients. I wish to discuss this point in more detail. In any two or more stage operation I always attempt (when in my judgment the patient's condition does not warrant a complete intestinal resection) to make a hurried lateral anastomosis thereby permitting the bowel content to pass through the rectum in a normal manner. This

procedure has a two fold purpose to permit the two resected segments of bowel distal to the anastomosis to decompress the small intestine temporarily during the stage of paralytic ileus caused by the

In Case I, despite the desperate condition of the patient I was able to make a lateral anastomosis in healthy bowel after drawing out approximately 6 feet of gangrenous small intestine, and rapidly attach the intestinal segments to the abdominal wall far enough distal to the anastomosis to permit no interference to the flow of the intestinal contents, concluding the first stage of the operation by making a firm closure of the abdominal wall around the protruding intestinal segments. In my opinion it is all important to leave enough intestine between the anastomosis and the point of attachment of the two intestinal segments to the abdominal wall. Ordinarily the protruding loops of intestine may be resected at the completion of this stage, but in this case the condition of the patient was so critical that we chose to continue with administration of whole blood and other intravenous solutions, to which he quickly responded, until the next morning, before resecting the gangrenous intestine.

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ab to continue the necessary dressings. The patient has reported weekly, and on October 12, 1946 the abdominal wound is healing satisfactorily and the bowels are moving normally, with only a slight discharge of intestinal content from the wound.

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most use of whole blood, plasma and combinations of solutions of amino acids. It has been my practice for many years to use whole blood routinely, not only in acute major surgical conditions but also in chronic conditions such as gallbladder and stomach disease and all types of early surgery. For the administration of whole blood to the critically ill patient, I use immediate form of anesthesia.

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As I have already pointed out in the discussion of the individual cases in this clinic, it is my opinion that many lives may be saved by the employment of stage operations. As a matter of fact, we employ multiple stage procedures in the surgical treatment of many critically ill patients.

SURGICAL SEQUELAE FOLLOWING RECOVERY FROM A PERFORATED PEPTIC ULCER

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KARL A. MEYER, M.D., F.A.C.S.‡

ALTHOUGH the treatment of peptic ulcer has reached a remarkable degree of standardization and unanimity of opinion, certain erroneous concepts still exist and enjoy rather widespread acceptance. One of these misconceptions is the belief that an ulcer which perforates cures itself and the patient. This theory was initially popularized by Balfour,¹ Clairmont,² Mayo³ and others and has since been handed down to medical students as dogma.

As surgeons we have been frequently called upon to treat patients with peptic ulcer by operative methods and we have been impressed with the frequent antecedent history of a perforated ulcer. If we reflect that what is actually done at the time of closure of the perforation in no way influences the etiological factors producing the ulcer, we are well entitled to doubt what we were taught as students. Not a few surgeons have attempted to evaluate their results following this procedure (Table 1) but usually the numbers of patients were relatively small and the statistical analysis accordingly variable. It therefore appeared worthwhile to report a relatively large series of cases from a charity hospital.

The scope of this report should be defined at the very outset. By surgical sequelae of a perforated ulcer we imply the development of ulcer complications which might constitute an indication for surgical intervention. Specifically, this would mean reperforation, hemorrhage, obstruction, intractable pain, or combination of these. Our patients are gathered from an indigent population wherein postoperative follow-up is well nigh impossible. It was deemed more advisable, therefore, to gather the records of peptic ulcer patients who previously perforated and learn what led them to seek readmission to the hospital. A smaller series of patients is now being followed in our gastrointestinal clinic,

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TABLE 1—PREVIOUSLY REPORTED LATE RESULTS OF ACUTE PERFORATED PEPTIC ULCER TREATED BY SIMPLE SUTURE

Author	Year Reported	Number of Cases Followed	Number of Cases Well	Number of Cases Not Well	Number of All Followed Cases Having Reoperation
Brown	1902	26	15 (60%)	10 (40%)	
Mills	1905	7	1 (14%)	6 (86%)	1 (14%)
Platou	1909	25	6 (24%)	19 (76%)	11 (44%)
Lerut	1909	22	11 (50%)	11 (50%)	5 (23%)
Dixen	1909	95	77 (81%)	18 (19%)	10 (11%)
Bryce	1930	100	52 (52%)	48 (48%)	15 (15%)
Hinton	1931	43	23 (53%)	20 (47%)	8 (18%)
White and Patterson	1931	19	13 (68%)	6 (32%)	2 (10%)
Shelley	1931	29	12 (51%)	17 (49%)	
Gilmore and Saint	1932	44	17 (40%)	27 (60%)	
Scott	1933	63	22 (40%)	41 (60%)	
Rousselin	1933	27	17 (44%)	10 (36%)	5 (19%)
Calvet	1933	15	5 (33%)	10 (67%)	3 (33%)
Salick	1936	45	16 (36%)	29 (64%)	
Guthrie and Sharer	1936	53	41 (77%)	12 (23%)	10 (19%)
Lab glis	1936	37	20 (54%)	17 (46%)	7 (19%)
Manno	1936	10	3 (30%)	7 (70%)	
Raven	1936	58	32 (55%)	26 (45%)	15 (23%)
Cable	1938	24	8 (33%)	16 (67%)	
Edmond and Thayer	1938	22	15 (68%)	7 (32%)	4 (18%)
Lebl J. V.	1938	74	2 (8%)	72 (92%)	4 (16%)
Thompson H. L.	1939	49	12 (24%)	37 (76%)	2 (4%)
Parker L. F.	1941	18	6 (33%)	12 (67%)	6 (33%)
Harrison, C. Cooper W. Jr.	1942	39	7 (18%)	32 (82%)	
Eates W. L. Bennett, B. A.	1944	53	3 (5%)	50 (95%)	8 (15%)
Williams, A. C.	1944	100	29 (29%)	71 (71%)	11 (11%)
Illingsworth C. F. W. Scott, L. D.	1946	73	7 (10%)	66 (90%)	15 (20%)
Forty Frank	1946	100	47 (47%)	53 (53%)	15 (15%)

* Table to this point taken from Parker & F.

of patients we will report demonstrates the need for such cooperative care in the management of the peptic ulcer patient

RESULTS

In the seven year period from 1939 to 1945 inclusive, 4355 patients with peptic ulcer were admitted to the wards of the Cook County Hospital complaining either of intractable pain, bleeding, pyloric obstruction, perforation or combinations of these. As indicated in Table 2, the number of ulcer patients admitted was progressively smaller each year, explainable on the basis of reduced hospital census characteristic of all charity hospitals during prosperity. However, the percentage of patients readmitted with a history of ulcer perforation was rather consistent through these years, varying between 11 and 14 per cent of all ulcer patients admitted each year. The 574 patients who were treated for a perforated ulcer and recovered does not indicate another 187 patients with perforated ulcer who died of their disease. It is not the purpose of this paper to discuss the reasons for this imme-

diate mortality rate of 24 per cent, we are principally interested here in the perforated ulcer patients who lived and developed late ulcer complications

During the same seven year period in which 574 patients recovered from a perforated peptic ulcer, 239 ulcer patients were admitted with a history of a *previous perforation* and a present complaint referable to any one of the aforementioned ulcer complications. Only four of these patients were female. Inasmuch as some of the histories of earlier perforation goes back as far as thirty years, it is apparent that not all of the 239 patients come from the 574 treated between 1939 and 1945. The important fact is that during an identical period in which 574

TABLE 2 — PERCENTAGE OF PERFORATED ULCER AMONG ALL ADMISSIONS FOR ULCER AND PERCENTAGE OF READMISSIONS

Year	Ulcer Patients Admitted All Types	Perforated Ulcer Patients Sutured and Recovered		Previously Perforated Ulcer Patients Readmitted	
		Number	Per Cent of Total Admissions for Ulcer	Number	Per Cent of Total Admissions for Perforation
1939	717	96	13	35	36
1940	809	118	11	31	29
1941	761	83	12	36	41
1942	629	89	11	33	37
1943	549	61	11	26	42
1944	436	56	13	39	31
1945	451	66	15	36	39
Total	13,000	574		239	41.6

patients recovered from a perforation, another group, 41.6 per cent as large had already developed further ulcer sequelae

Figure 34 represents a breakdown of the 239 cases as to the exact ulcer complaint with which each of these previously perforated patients now presented themselves. Because many of these patients developed multiple complications, the total number of complications will exceed the total number of patients. It is of considerable interest to note that 86 per cent of this group (207 patients) complained of intractable abdominal pain. It was the most frequent reason for which

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Platon	1929	25	6 (24%)	19 (76%)	11 (44%)
Urrutia	1929	22	11 (50%)	11 (50%)	5 (23%)
Dunson	1929	92	77 (84%)	15 (16%)	10 (11%)
Bryce	1930	100	32 (32%)	68 (68%)	15 (15%)
Hinton	1931	43	23 (53%)	20 (47%)	8 (18%)
White and Patterson	1931	19	13 (68%)	6 (32%)	2 (10%)
Shelley	1932	29	15 (51%)	14 (49%)	
Gilmore and Saint	1932	44	17 (40%)	27 (60%)	
Scott	1933	63	25 (40%)	38 (60%)	
Houmelius	1933	27	12 (44%)	15 (56%)	5 (19%)
Calvert	1935	12	5 (42%)	7 (58%)	3 (25%)
Sellick	1936	45	16 (36%)	29 (64%)	
Guthrie and Sharer	1936	53	41 (77%)	12 (23%)	10 (19%)
Cabaglio	1936	37	20 (54%)	17 (46%)	7 (19%)
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W. Jamison R. A.	1946	773	77 (10%)	541 (70%)	132 (17%)
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to any one of the aforementioned ulcer complications. Only 1001 of these patients were female. Inasmuch as some of the histories of earlier perforation goes back as far as thirty years, it is apparent that not all of the 239 patients come from the 574 treated between 1939 and 1945. The important fact is that during an identical period in which 574

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Total	4333	574		239	41.6

patients recovered from a perforation, another group, 41.6 per cent as

to the exact perforated patients now presented themselves. Because many of these patients developed multiple complications, the total number of complications will exceed the total number of patients. It is of considerable interest to note that 86 per cent of this group (207 patients) complained of intractable abdominal pain. It was the most frequent reason for which these patients sought readmission to the hospital. It varied in severity and character and was often associated with bleeding or pyloric obstruction in addition. The quality of the medical management varied—in the majority it was rather superficial.

The incidence of hemorrhage as a complication of previously perforated ulcer was 34 per cent (eighty-two cases) of the 239 read-

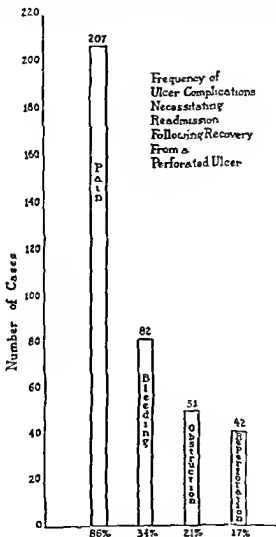


Fig 34

patients dying of hemorrhage proved at autopsy to have a second perforation as well

Pyloric obstruction as a late sequel of perforation was present in fifty one (21 per cent) of the series of 239 patients. This was usually due to scar formation, occurring in patients who were discharged from the hospital and then readmitted after varying intervals. Pyloric obstruction also occurs not infrequently within the immediate post-operative period following the closure of the perforation, this we

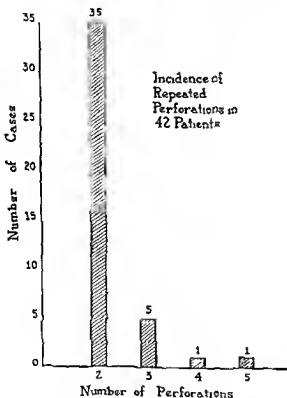
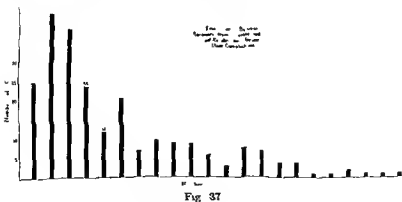
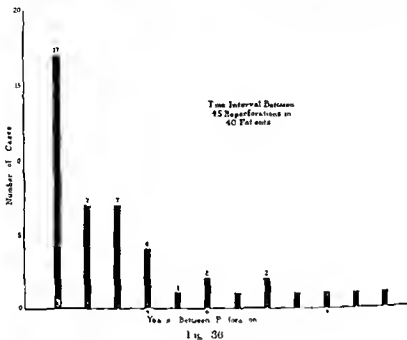


Fig 35

believe to be due either to the edema associated with the hypoproteinemia of starvation and peritonitis or to overzealous efforts in covering the site of perforation. Later in this paper we shall chiefly present

... that in five patients perforation occurred three times,

in one four times, and in one five times. Two of these iterative perforations were from marginal ulcers following gastroenterostomy, and



of four and five perforations. Seventy seven per cent of these repeated perforations occurred over a four year period. The longest time interval between perforations was twenty eight years and the shortest six months. Eight of the thirty one patients suffering re-perforations operated upon in this institution died, a mortality rate of 26 per cent, in three of them bleeding and perforation occurred simultaneously. This does not greatly exceed the mortality rate of 24 per cent for initial perforation.

Figure 37 illustrates the time interval elapsing between the initial perforation and the development of complications in the 239 patients readmitted. It is noteworthy that 28 per cent of the 239 patients had in validating ulcer symptoms by the end of two years and 68 per cent by the end of five years. Sixteen and three-tenths per cent of these

TABLE 3—CAUSES OF DEATH IN EIGHTEEN PATIENTS WITH ULCER COMPLICATIONS FOLLOWING AN EARLIER PERFORATED ULCER

Reperforation	5 deaths
Elective surgery	3 deaths
Gastric resection	3 deaths
Gastroenterostomy	5 deaths
Later abscess 4 months after repair of perforation	1 death
Cerebrovascular accident	1 death
	<u>18 deaths</u>

patients were readmitted after ten years. The longest interval between perforations and reentry to the hospital was thirty years.

Operative intervention was required in seventy one of the 239 patients (approximately 30 per cent). Forty seven were treated by subtotal gastric resection and twenty four by gastroenterostomy. There were five deaths among these seventy one operated patients, a mortality rate of 7 per cent. Of the forty one patients undergoing gastrec-

tomies following ulcer perforation, repeated perforations accounted for eight of the eighteen deaths, three of which were associated with hemorrhages.

OPERATIVE PRINCIPLES

Although most of the sequelae following perforation of a peptic ulcer occur many years after surgery, we have seen not a few occur during the immediate postoperative period. This is particularly true of pyloric obstruction. In addition there are many other surgical com-

plications resulting from peritonitis rather than the ulcer. Both of these considerations emphasize the importance of sound surgical principles in the surgical management of the perforated peptic ulcer patient.

Anesthesia—Our preference has always been spinal anesthesia (Fig 38). The use of pontocaine with 10 per cent dextrose has produced satisfactory levels of anesthesia for periods of two to two and one-half hours. The hyperbaric character of the pontocaine-dextrose mixture allows a more gradual rise in the level of anesthesia. This type of anesthesia gives more complete relaxation of otherwise very rigid abdominal parietes, has a quieting effect upon the gastrointestinal tract, is more effective in minimizing postoperative ileus, gives us a

Spinal Anesthesia.

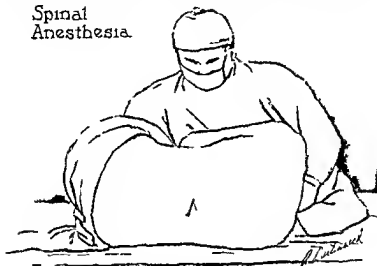


Fig 38 The anesthesia of choice

conscious patient who is able to cough and expectorate after operation and demands less immediate postoperative care.

as represented in Figure 33 it will be noted that we use only permanent sutures on atraumatic needles, that these are used as interrupted sutures, and that they are tied loosely enough so that there is no

strangulation of tissue with subsequent necrosis and leakage. We deliberately avoid the use of purse string sutures for they have a constricting effect upon a lumen which may well lead to stenosis (Fig 40). It also places too much faith in a single strand of suture material

Perforated Peptic Ulcer Technic of Repair

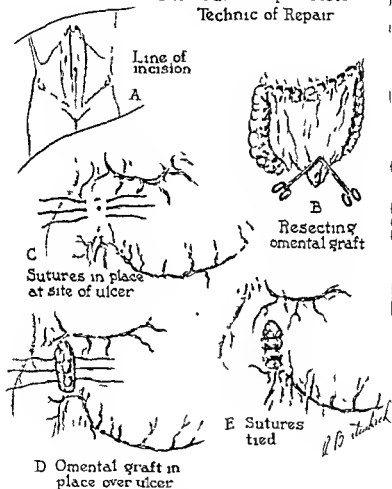
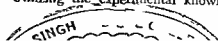


Fig 39

We have also discouraged the use of catgut sutures because, in the presence of acute inflammation, such sutures are more rapidly digested and are less dependable.

Omental Grafts—Utilizing the experimental knowledge that fat



tissue resists the digestive effects of duodenal fistulae rather well, we
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Procedures Not Recommended

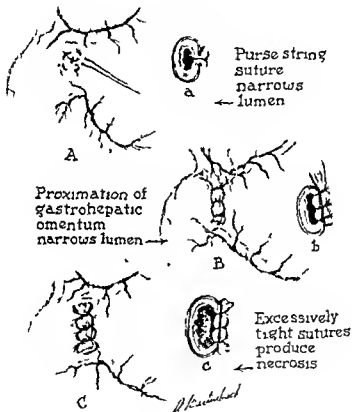


Fig 40

because of the stenotic effect upon the lumen of the duodenum (Fig 40, B) We know of no instance in which this free omental graft closure with a single row of interrupted silk sutures has resulted in an immediate subsequent reperforation

Aspiration.—Aspiration of the peritoneal cavity, holding the suction bucket within the cupped exploring hand, is carried out routinely to minimize the incidence of postoperative abscess (Fig 41, B) In par

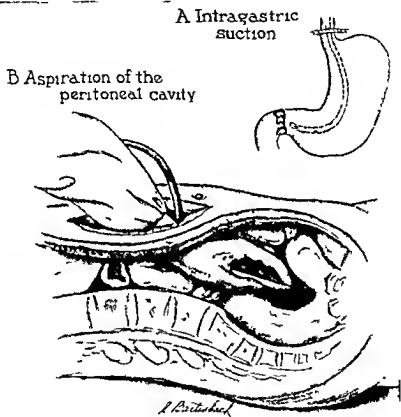


Fig 41

ticular the subhepatic space, both lumbar gutters and the pelvis are evacuated, for these are the sites to which peritoneal exudate will gravitate

Sulfonamides—Intraperitoneal sulfonamides are introduced just prior to closing the peritoneum Over recent years we have used sulfanilamide, sulfathiazole and sulfadiazine, depending upon the choice of the individual operator However, one should use the same drug

intraperitoneally that he will later use intravenously so that blood levels of the drug can be determined more accurately. In recent months there has been a decreased use of these drugs intraperitoneally with a preference for intravenous administration postoperatively.

Drains.—No drains are inserted, either into the peritoneal cavity or the abdominal wound. In the first place, it is unlikely that a drain can siphon intraperitoneal contents after the first few hours; later it is so well walled off by fibrinous adhesions that in all likelihood it is isolated from the remainder of the peritoneal cavity. Secondly, a drain will do little toward preventing abscess formation for it rarely reaches the

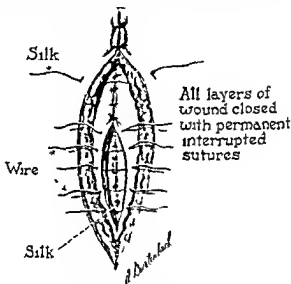


Fig. 42

sites where abscesses are most apt to form. Finally, this type of pentonitis here is quite

for the peritoneum and stainless steel wire for the rectus fascia but we believe other permanent suture material would be just as acceptable. The use of this method of closure of the wound decreases the incidence of wound dehiscence and enables the patient to get out of bed from the very day all signs of peritonitis have disappeared (usually the third or fourth postoperative day). Early rising in itself will minimize many common postoperative complications.

POSTOPERATIVE CARE

Intragastric suction should be instituted before operation to decompress the stomach, prevent aspiration and minimize postoperative ileus. With such a tube in place we are quite willing to allow the patient to drink fluids to satisfy his thirst instead of insisting on the oral starvation so characteristic in the past. We do not appreciate how a fine intragastric tube can produce sufficient trauma within the stomach or duodenum to disturb the healing of an ulcer (Fig 41, A). Such a theory presupposes that the tube lies in direct contact with the ulcer crater and further that it remains there. Actually, neither of these two situations is likely. The tube is left in place until the return of active peristalsis, passage of flatus or stool or a positive "pyloric balance" as determined by intake and output calculations has occurred. This usually takes place on about the third postoperative day.

Parenteral fluids are administered daily in minimal amounts of 3000 cc while the patient is on gastric suction. If the patient loses excessive quantities through the suction apparatus this should be made up by an additional equal quantity of saline. Because of an acute need for protein due to the peritonitis and enforced starvation some part of the 3000 cc daily parenteral intake should consist of blood plasma or amino acids. There is in addition a need for parenteral vitamins B and C to facilitate carbohydrate metabolism and wound healing respectively.

Parenteral electrolytes are administered daily in minimal amounts of 3000 cc.

Increases the incidence of immediate surgical complications or the recovery from the peritonitis remains to be proved.

Oral feedings are commenced from the day the gastric tube is withdrawn, starting with small frequent feedings of soft bland protein containing foods and progressing to some type of ambulatory ulcer diet by the time the patient is ready to be discharged.

An active *ulcer regimen* is instituted as soon as the patient demonstrates an ability to retain gastric feedings. The patient should be advised to remain on this management for a minimum of six months or until healing of the ulcer can be objectively demonstrated.

COMMENT

It is of utmost importance to be able to offer the patient some statistical guide as to his chances for future ulcer difficulties upon his discharge from the hospital.

As many as 34 per cent of the patients were not well. How

ever more unanimity exists among reports since 1938 in which the incidence of relapse of symptoms averages 73 per cent. Our incidence of 41.6 per cent of recurring symptoms does not present the entire picture for it covers only patients whose symptoms demanded hospitalization. Obviously there must be a large group whose milder symptoms would be known only to a gastrointestinal clinic. Obviously it is sound practice to remind the patient with a healed perforated peptic ulcer that his ulcer proclivities are still at their peak and demand continuous and intensive ulcer management.

Not only is it important for the patient and the physician to appreciate the possibility of a relapse of symptoms but familiarity with their character and frequency is also important. Our data (Fig. 34) suggests that ulcer pain is by far the most frequent complication. Fortunately it is also the symptom most amenable to conservative therapy. Next in order of frequency are bleeding, pyloric obstruction and reperforations. The fact that there were 382 such complications in 239 patients would further emphasize a tendency for multiple complications to occur in one patient.

It is not generally appreciated that a peptic ulcer can perforate more than once. Our incidence of reperforation was 4 per cent in all peptic ulcer patients admitted to the hospital. This is the same incidence cited by Cohn⁴ but exceeds that reported by others (Pearse⁵, DeBakey⁶, Ulfelder and Allen⁷, Williams⁸). Estes and Bennett⁹ recently reported that a second perforation developed in seven of their fifty cases. If the figures given by Cohn, by Estes and Bennett and by ourselves are confirmed by others, then certainly this becomes another consideration in the decision of what plan of management is best for the patient.

The mortality rate following closure of a reperforation was 26 per cent whereas following the initial perforation the rate was 24 per cent. Although one might expect a higher rate with each repeated perforation, actually, Pearse⁵ reported only three deaths in thirty-three patients operated upon for a reperforation. Pearse offered several explanations for the decreased mortality rate such as local tissue immunity, adhesions and earlier diagnosis. The fact that three of eight of our patients with reperforations who died also had bleeding from the ulcer might explain the difference in our mortality rate and that of Pearse.

Williams⁸ was of the opinion that the longer the time interval after perforation the less the likelihood of a relapse. Although in our series the majority of these ulcer complications manifested themselves in the first five years, a sufficient number made their appearance as late as thirty years after the first perforation and led us to conclude that time confers little immunity. Holland and Logan¹⁰ reported the development of pyloric obstruction in one patient thirteen years after perforation and bleeding in another eighteen years after perforation.

Approximately 30 per cent of the patients readmitted required further operative work. This is considerably in excess of the general average of 19 per cent incidence of reoperation among the cases reported in Table 1. In part, this is explainable by a more aggressive attitude toward the surgical attack of peptic ulcer shown by our surgical staff in recent years, which is undoubtedly ascribable largely to the better preoperative and postoperative care available. Another motivating factor is the knowledge that the results with medical management of peptic ulcer amongst an indigent type of patient is much less satisfactory than in private practice, this must necessarily influence the surgeon when he weighs the criteria for operation.

Recently, the suggestion has been made that in favorable subjects with a short history of symptoms, gastric resection should be performed at the time of closure of the perforation. The surgical mortality rate for gastric surgery following perforation was only slightly higher than that usually reported from charity services for unselected gastric resections for peptic ulcer. There are valid arguments for discouraging such a practice. Obviously the mortality rate for gastrectomy in the presence of perforation would soon rise to extreme levels if the practice became widespread. But even more important is the knowledge that a minority of the patients, even under inadequate postperforation follow up, will require further surgery. It will be of interest to note in the future if fewer than 30 per cent of our patients with perforated ulcer come to subsequent operation as a result of the improved care provided by our gastrointestinal clinic.

SUMMARY

- 1 Forty one and six tenths per cent as many patients recovering from a perforated peptic ulcer developed subsequent ulcer symptoms requiring hospitalization.
- 2 Pain was responsible for the readmission of 86 per cent of 239 patients with a previous perforated ulcer.
- 3 Bleeding was responsible for the readmission of 34 per cent of these 239 patients.
- 4 Pyloric obstruction was present in 21 per cent of the readmitted cases.
- 5 Two or more perforations were seen in 17 per cent of this group of cases.
- 6 Further gastric surgery was required in 30 per cent of the patients readmitted following recovery from a perforated peptic ulcer.
- 7 The chances of a patient with a perforated peptic ulcer requiring further gastric surgery are not great enough to justify gastric resection at the time of closure of a perforation.
- 8 An intensive postperforation ulcer program is mandatory if the

patient is to be spared many of the ulcer complications he is now heir to

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TRANSABDOMINAL REPAIR OF ESOPHAGEAL HIATUS HERNIA

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JOHN W McCALLISTER, M D †

ESOPHAGEAL hiatus hernia is the most common hernia through the diaphragm found in adult life. It constitutes over one third of all diaphragmatic hernias and more than two thirds of all nontraumatic diaphragmatic hernias.¹ Slightly over 1 per cent of all adults have been found to have viscus protrusions of varying degrees through the esophageal hiatus in series of routine roentgen examinations of the

through the defect into a triangular niche³ bounded by pericardium anteriorly, the aorta posteriorly, and the mediastinal pleura and pulmonary ligament laterally. The sac usually underlies the left mediastinal pleura, but on occasion may pass into the right hemithorax.

Contents of the hernia sac usually include the cardia and fundus of the stomach. The spleen or a loop of bowel is rarely included. The esophagus is most often pushed in a posterior direction and tends to fold upon itself as the cardia slips upward. The ascent of the greater curvature tends to obliterate the gastrophrenic ligament,⁴ in addition

ity of such hernias do not produce symptoms severe enough to necessitate surgical intervention. Case records at the Wesley Memorial Hospital show that four out of five diagnoses of esophageal hiatus hernia are made as incidental findings, or the symptoms produced do not merit surgery.

The frequent occurrence of esophageal hiatus hernia and the elective nature of the operation render all the more surprising the lack of a standardized approach and method of repair. Controversy exists between surgeons favoring transthoracic operation and those employing

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the abdominal approach. It is our purpose to describe herewith a method of repair of such hernias utilizing an abdominal incision. In our hands this method has proved to be satisfactory for purposes of exposure exploration reduction and repair.

ADVANTAGES OF THE ABDOMINAL APPROACH

The advantages of the abdominal approach are presented along with some objections to the transthoracic route.

1 Exposure through an abdominal incision is adequate.

2 Abdominal incision permits exploration for determining the presence of additional intra abdominal pathologic states. There is a surprisingly high incidence of coexistent disease which may produce the symptoms attributed to the hernia.³ This is particularly true of concomitant biliary tract disease.

3 Reduction of the hernia is easier from below. Complication by intrathoracic adhesions seems not to be a real problem in practice.

4 The sac may be dealt with adequately from the abdominal side.

5 Repair through an abdominal incision can be carried out without difficulty.

6 Transthoracic operation is a lengthier procedure produces a surgical pneumothorax frequently requires intubation anesthesia and is followed by more postoperative pulmonary morbidity. In the event of the passage of the sac into the right hemithorax approach through the left chest is unsatisfactory.

ANATOMICAL CONSIDERATIONS

Difficulties in the repair of an esophageal hiatus hernia may be avoided or minimized by reviewing some practical points of the anatomy of the region.

Topographically the esophageal hiatus may be located at the level of the upper margin of the tenth thoracic vertebra 1 cm from the midline 7.5 to 10 cm deep to the upper margin of the left sixth costal cartilage. Passing through the hiatus are the esophagus right (posterior) and left (anterior) vagus nerves and the esophageal branches of the left gastric artery and coronary vein. These latter structures are so closely associated with the esophagus that no concern need be felt for their safety during repair.

The left lobe of the liver supported by the left triangular and coronary ligaments lies anterior to the cardia and hiatus. The liver

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repeatedly

The location of the esophagus posterior to the pericardium must be borne in mind. The pericardium is adherent to the central tendon of

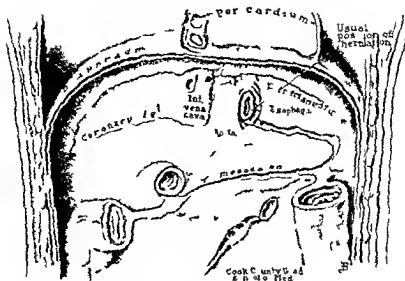


Fig 43 Frontal section through diaphragm. Liver, stomach, spleen and transverse colon removed. Note position of esophageal hiatus in relation to left triangular ligament, aorta and pericardium.

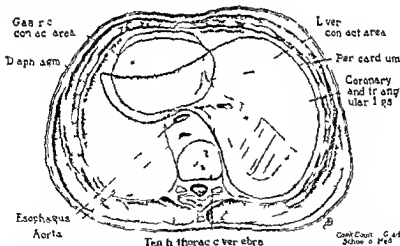


Fig 44 Superior surface of diaphragm showing position of stomach, liver and liver attachments in relation to structures above and passing through the diaphragm. Note especially the relations of pericardium, esophagus and aorta. (Adapted from Persol)*

the diaphragm and the esophagus is normally adherent to the posterior aspect of the pericardium. The esophagus is in contact with the

right and left pleurae just before it passes through the diaphragm. The sac of a hiatus hernia may then be contiguous with esophagus per

atrium. Proper orientation of the position of all these structures above and below the diaphragm is essential. Figures 43 and 44 are designed to correlate the positions of supra- and infraphrenic structures.

PREOPERATIVE PREPARATION

Preoperatively the usual careful physical and laboratory studies are carried out. In addition the large bowel is given a thorough cleansing by repeated enemas. A poorly prepared colon is the greatest single hindrance to good exposure in this operation. Careful attention is given to the oral hygiene. Only clear liquids are given by mouth in the twenty-four hours preceding surgery. If a Levin tube can be inserted with ease, continuous suction is employed for twelve hours before sur-

tion and gastric suction wherever possible serve two purposes: (1) an empty stomach obviates the danger of regurgitation and aspiration during manipulation, and (2) provides better exposure by collapsing the stomach. On the operating table the patient is placed in the dorsal recumbent position. We have not found hyperextension of the back or depression of the right side of the table to be helpful or necessary. The surgeon stands in his customary position at the patient's right.

A rectal tube is inserted and left in place, as is our practice in all

satisfactory. Endotracheal anesthesia is not routinely employed, since the closed system with mask is adequate to control whatever respiratory difficulties might arise.

TECHNIC

A left subcostal incision from the medial fibers of the right rectus muscle close to the rib margin extending to the anterior axillary line provides good exposure (Fig. 43 A). A Balfour retractor is installed before exploration is carried out. The transverse colon, mesocolon and splenic flexure are packed caudad and to the left with moist lap sponges. The left lobe of the liver is depressed to expose the triangular ligament (Fig. 45 B). The left triangular ligament and most lateral portion of the coronary ligament are divided. The liver is protected with a moist lap sponge, then gently retracted downward and to the

right with a broad Deaver retractor. The enlarged hiatus may now be examined. Gentle downward traction on the body of the stomach will release the herniated portion of the stomach and straighten the distal

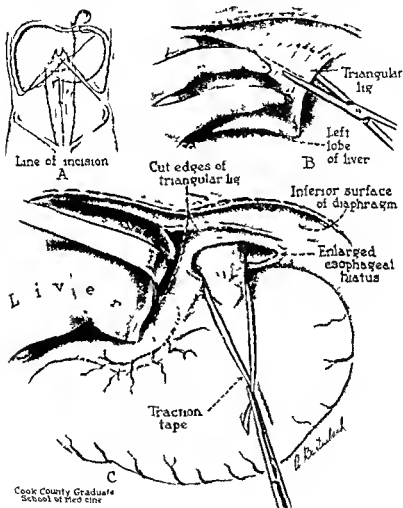


Fig 45—A Location of incision B Division of left triangular ligament C Liver retracted, traction tape placed about stomach

esophagus. Next, a length of cord tape is passed over the gastrolenal ligament into the omental bursa and out through the gastrohepatic ligament. This loop of tape over the fundus and lesser curvature (Fig

right and left pleurae just before it passes through the diaphragm. The sac of a hiatus hernia may then be contiguous with esophagus pericardium, aorta, and right or left pleura

Suture of the esophagus

and below the diaphragm is essential. Figures 43 and 44 are designed to correlate the positions of supra- and infradiaphragmatic structures

PREOPERATIVE PREPARATION

Preoperatively, the usual careful physical and laboratory studies are carried out. In addition, the large bowel is given a thorough cleansing by repeated enemas. A poorly prepared colon is the greatest single

with ease continuous suction is employed for twelve hours before surgery. Any difficulty in passing the tube beyond the cardia suggests that there is kinking of the esophagus. To force passage of the tube under such circumstances is dangerous and installation is deferred. Intubation and gastric suction wherever possible serve two purposes: (1) an empty stomach obviates the danger of regurgitation and aspiration during manipulation, and (2) provides better exposure by collapsing the stomach. On the operating table, the patient is placed in the dorsal recumbent position. We have not found hyperextension of the back or depression of the right side of the table to be helpful or necessary. The surgeon stands in his customary position at the patient's right.

A rectal tube is inserted and left in place, as is our practice in all

satisfactory. Endotracheal anesthesia is not routinely employed, since the closed system with mask is adequate to control whatever respiratory difficulties might arise.

TECHNIC

A left subcostal incision, from the medial fibers of the right rectus

sponges. The left lobe of the liver is depressed to expose the triangular ligament (Fig. 45, B). The left triangular ligament and most lateral portion of the coronary ligament are divided. The liver is protected with a moist lap sponge, then gently retracted downward and to the

right with a broad Deaver retractor. The enlarged hiatus may now be examined. Gentle downward traction on the body of the stomach will release the herniated portion of the stomach and straighten the distal

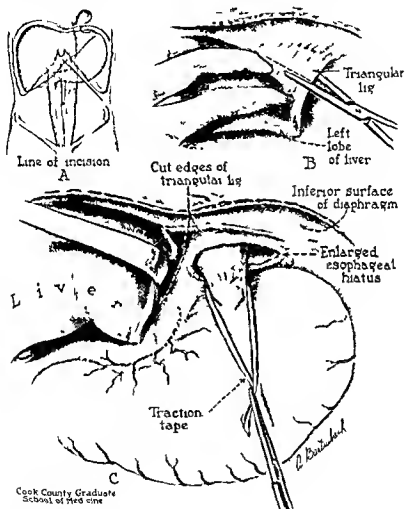


Fig 45—A Location of incision B Division of left triangular ligament C Liver retracted, traction tape placed about stomach

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right and left pleurae just before it passes through the diaphragm. The sac of a hiatus hernia may then be contiguous with esophagus pericardium, aorta, and right or left pleura.

Suture of the enlarged hiatus carries the operator very close to the aorta, the esophagus itself, the base of the pericardium and to the left atrium. Proper orientation of the position of all these structures above and below the diaphragm is essential. Figures 43 and 44 are designed to correlate the positions of supra- and infraphrenic structures.

PREOPERATIVE PREPARATION

Preoperatively the usual careful physical and laboratory studies are carried out. In addition the large bowel is given a thorough cleansing by repeated enemas. A poorly prepared colon is the greatest single hindrance to good exposure in this operation. Careful attention is given to the oral hygiene. Only clear liquids are given by mouth in the twenty-four hours preceding surgery. If a Levin tube can be inserted with ease, continuous suction is employed for twelve hours before sur-

empty stomach obviates the danger of regurgitation and aspiration during manipulation and (2) provides better exposure by collapsing the stomach. The dorsal back or necessary

The surgeon stands in his customary position at the patient's right.

A rectal tube is inserted and left in place, as is our practice in all laparotomy cases. Normal saline solution is started intravenously prior to operation and compatible blood is held in readiness.

Cyclopropane ether anesthesia given in a closed system has proved employed, since whatever respira-

TECHNIC

with a moist lap sponge then gently retracted downward and to the right. The rectus abdominis muscle is then palpated and the lap

with a moist lap sponge then gently retracted downward and to the

down by reason of its attachment to the stomach. The evaginated sac forms a loose fold of peritoneum having the appearance of a redundancy in the normal anterior reflection of peritoneum from the diaphragm onto the stomach and esophagus (Fig 46, A). The diaphragmatic defect lies outside this loose fold. Division of this loose peritoneal fold by scissor dissection follows. The upper margin of this redundant peritoneal cuff is elevated with long Allis or sponge holding forceps. Depertonealized esophagus and the edges of the diaphragmatic defect are now exposed. The traction tape is slipped upward and tightened about the lower end of the esophagus. Exposure is improved by having the first assistant press the esophagus posteriorly with a finger of his left hand. Edges of the diaphragmatic defect are grasped with three long Allis forceps—one at the middle of the anterior margin of the enlarged hiatus, and one on each side at the level of the anterior esophageal wall (Fig 46, B). In this way, the defect is converted to

- 2 The position of the aorta is identified by palpation before placing each suture
- 3 Sutures are placed with the needle point going away from the aorta
- 4 Each suture must be made under direct vision. A deep, blindly placed suture could injure the pericardium or left atrium
- 5 None of the sutures are tied until all have been placed
- 6 Each suture is held with forceps, providing traction to make insertion of succeeding sutures easier

The first suture is placed at the apex (anterior angle) of the hiatus, passing through the two limbs of the defect (Fig 46, B). Succeeding sutures, placed 8 to 10 mm apart, are used to approximate the edges of the defect until the hiatus is reduced to normal size. These sutures do not penetrate any portion of the esophagus. Perforation of the esophagus during suture of the diaphragm is the most common serious mishap associated with repair of hiatus hernias. After the sutures are tied and cut, the loose peritoneal cuff is dropped. It may or may not be sutured in place. The left lobe of the liver is allowed to fall back into its normal position. Repair of the left triangular ligament is not necessary.

POSTOPERATIVE CARE

Feeding is begun orally for the first few days. The patient is kept on a liquid diet for forty eight hours. Prophylaxis against pulmonary complications following laparotomy is observed. Relief from symptoms is usually immediate and gratifying.

45, C) provides a simple mechanism for traction on the stomach and distal esophagus. The peritoneum of the sac is continuous with the peritoneum of the inferior surface of the diaphragm at the anterior

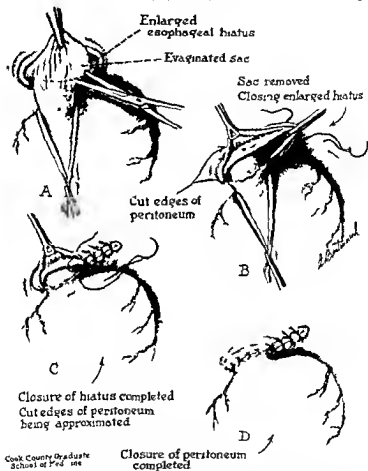


Fig 46—A, Division of peritoneum of evaginated sac B Retraction of peritoneal cuff Support of margins of defect. First suture being placed C and D Completed repair

margin of the defect. The posterior margin of the sac is attached near the cardia, where the peritoneum becomes gastric serosa. When the stomach is brought down from the thorax the sac will be dragged

METHODS OF NERVE REPAIR

LOYAL DAVIS, PH D, M D, D SC., F A C S,* AND
GEORGE PERRET, M D †

INTRODUCTION

MOST of our knowledge of peripheral nerve injuries and peripheral nerve surgery has been gained from experiences with war casualties and experimental work stimulated by the problem of treatment of such casualties. In civilian life nerves are most commonly injured directly by stab wounds, glass splinters or other sharp or cutting objects, or indirectly as the result of crushing injuries to the extremities, of fractures or callus formation, of pressure from casts, bandages or tumors of prolonged stretching or continuous mild trauma.

When a peripheral nerve is severely injured or severed there ensues a paralysis of the muscles innervated by its distal branches a loss of touch temperature pain and deep sensibility in the area supplied by it and a loss of vasomotor supply and trophic changes. The paralysis is flaccid in character and immediately a progressive atrophy begins in the paralyzed muscles. Atrophy may be followed by fibrosis of the muscle stretching or shortening of tendons contractures due to overaction of antagonistic groups of muscles and ankylosis of joints. A severed or injured nerve undergoes wallerian degeneration in its entire course distal from the site of injury. This means that axis cylinders and myelin sheaths degenerate in the entire distal segment of the nerve as far as the sensory end organs in the skin, the motor end plates in the muscles and the fibrils in the sweat glands and the blood vessels. It should be remembered that the longer a muscle remains denervated the more severe the atrophy and the fibrosis will be and the less chance it will have for later recovery of function. When regeneration takes place, new nerve fibers often must grow long distances to supply the most distant parts of the extremities. Nerve fibers regenerate at a rate of 2 to 3 mm a day under favorable conditions and the connection with old motor end plates or the formation of new end plates in atrophic muscle fibers may take from thirty to sixty days, so that evidence of recovery may not become apparent for months or even years after a nerve has been repaired even under ideal circumstances.

SURGICAL INDICATIONS

There is no way by which a complete loss of function due to an anatomical interruption can be differentiated from that due to a physio-

From the Department of Surgery, University of Chicago.

SUMMARY

1. The frequency of occurrence of esophageal hiatus hernia is described.

2. Attention is called to the lack of a standardized procedure for repair of such hernias.

3. Advantages of transabdominal repair of hiatus hernia are listed.

4. Discussion of the practical anatomy of the region in question follows. Particular attention is given to correlation of the position of structures above and below the diaphragm.

5. A step-by-step description of a satisfactory reparative operation utilizing a subcostal incision is presented.

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INTRODUCTION

Most of our knowledge of peripheral nerve injuries and peripheral nerve surgery has been gained from experiences with war casualties and experimental work stimulated by the problem of treatment of such casualties. In civilian life nerves are most commonly injured directly by stab wounds, glass splinters or other sharp or cutting objects, or indirectly as the result of crushing injuries to the extremities, of fractures or callus formation, of pressure from casts, bandages or tumors, of prolonged stretching or continuous mild trauma.

When a peripheral nerve is severely injured, or severed, there ensues a paralysis of the muscles innervated by its distal branches, a loss of touch, temperature, pain and deep sensibility in the area supplied by

stretching or shortening of tendons, contractures due to overaction of antagonistic groups of muscles and ankylosis of joints. A severed or injured nerve undergoes wallerian degeneration in its entire course distal from the site of injury. This means that axis cylinders and myelin sheaths degenerate in the entire distal segment of the nerve as far as the sensory end organs in the skin, the motor end plates in the muscles and the fibrils in the sweat glands and the blood vessels. It should be remembered that the longer a muscle remains denervated, the more severe the atrophy and the fibrosis will be and the less chance it will have for later recovery of function. When regeneration takes place new nerve fibers often must grow long distances to supply the most distant parts of the extremities. Nerve fibers regenerate at a rate of 2 to 3 mm a day under favorable conditions and the connection with old motor end plates or the formation of new end plates in atrophic muscle fibers may take from thirty to sixty days, so that evidence of recovery may not become apparent for months or even years after a nerve has been repaired even under ideal circumstances.

SURGICAL INDICATIONS

There is no way by which a complete loss of function due to an anatomical interruption can be differentiated from that due to a physio

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logical interruption of nerve fibers in an early lesion. Complete paralysis of all muscles supplied by a nerve below the level of the lesion, complete loss of sensation over the area of isolated sensory supply of the nerve and electrical reaction of degeneration are the only reliable signs of a complete interruption of function of a peripheral nerve. In most instances there are definite evidences of an anatomical severance such as a fresh wound, a healed scar or the presence of a fractured bone. When there is no evidence of anatomical severance and the nerve injury, either partial or complete, is not associated with an open wound, observation for one to three months and weekly examinations together with conservative treatment may be considered. However, as soon as indications of continued regeneration cease or electrical evidences of regeneration do not appear when expected or there is evidence indicating compression by scar tissue or callus rather than anatomical section, operation is indicated.

Suture of a severed nerve should be attempted immediately after the injury has occurred because the results of early repair are better than in delayed procedures. When in doubt, it is better to explore a nerve that does not show an interruption in its continuity than let a severed nerve go on to a point of irreparable damage for later function. Even though spontaneous recovery of a crushed nerve may take place in a certain number of patients, regeneration may be helped and hastened by liberating the nerve from scar tissue and by preparing a more suitable bed for the nerve. Therefore waiting for spontaneous recovery is unjustifiable in the majority of cases.

Nerve injuries in clean wounds should be repaired primarily. The wounds should be cleansed, debrided, the nerve sutured and the wound closed. The same treatment should be applied to fresh but contaminated wounds. Systemic chemotherapy with penicillin or sulfonamides should be instituted. Grossly infected wounds should be adequately debrided and nerve repair attempted if the nerve segments can be easily approximated. This also depends upon the extent of the wound. In wide, grossly infected wounds containing much necrotic tissue and in which débridement is not adequate, the severed nerve ends should be tied together with a metallic suture in order to keep

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nerve regeneration may take place in an infected wound and that
a not as vulnerable to infection as has been supposed. It has
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the distal nerve segment. It has also been shown that crystalline sulfanilamide, sulfathiazole or sulfadiazine powder used locally around a

repaired nerve does not interfere with the regeneration of nerve fibers. Wounds may be reopened and closed after the introduction of sulfonamide drugs with little or no danger of activating latent bacteria. It is not necessary therefore to allow a long interval of time to elapse between the time the wound is received and repaired to avoid infection of the wound.

The paralysis following bone fractures is usually temporary and the nerve regenerates spontaneously. However, if regeneration does not occur or if the nerve becomes embedded in callus, exploration of the nerve is indicated. In compounded fractures, the nerve should be either sutured immediately or its segments approximated at the time the fracture is reduced openly. In these cases the surgical treatment of the nerve depends to a large extent on the procedure necessary to reduce the fracture. It is advisable to explore a nerve injured by a fractured bone as early as possible, but manipulation of the bone fragments should precede nerve suture. The radial nerve is frequently injured in simple or compounded fractures of the humerus and tests for radial nerve function should always be done in such cases at the time the fracture is diagnosed. Fractures of the fibula also occasionally produce an injury to the peroneal nerve.

In civilian practice old nerve injuries are too frequently seen. A large number of the patients give a history of having had a nerve suture performed at the time the fresh wound was treated, and upon reoperation sutures of nerve to tendon are usually encountered. Sutures of the proximal ulnar or median nerve segment to the distal portion of the palmaris longus tendon or vice versa are commonly seen. The marked degree of muscle atrophy, fibrosis and contractures greatly diminish the chances of recovery of function even if nerve regeneration is satisfactory. However, nerve suture should be performed in spite of the degree of muscle atrophy, it is the only chance to improve function to an otherwise useless hand or foot. In the hands of a competent neurosurgeon, mistakes such as nerve tendon sutures should not occur.

METHODS OF NERVE REPAIR

Recovery of an injured nerve may be obtained by the following methods of repair used either singly or in combinations:

- 1 Mobilization of the nerve
- 2 Relaxation of the nerve
- 3 Transposition of the nerve
- 4 Primary and secondary
- 5
- 6
- 7 Nerve-to-nerve anastomosis

1. **Mobilization of the Nerve.**—Mobilization consists of freeing the nerve for a considerable distance above and below the lesion from the

scar tissue that may surround it and also its normal bed. This must be done carefully without disturbing or destroying the branches of the nerve or its germinal zone.

The distance thus gained does not exceed 3 cm., but is extremely useful in approximating the ends of a severed nerve.

2 Relaxation of the Nerve.—Relaxation is produced by mobilization of the neighboring joints and changes in the position of the affected limb. By flexion or extension, adduction or abduction, the nerve can be brought into a position of relaxation and distance can be gained. It has been shown by Babcock that by flexion of the wrist alone 4 to 5 cm. can be gained in relaxing the median or ulnar nerve, flexion of the elbow overcomes a gap of 5 to 7 cm. in the median or radial nerve, flexion of the knee and extension of the thigh will produce 8 to 12 cm. of sciatic nerve relaxation and extension of the elbow adds 2 cm. to the ulnar nerve. If such position changes are necessary to overcome nerve gaps, the extremity should be kept in that position with the help of splints or casts for several weeks after nerve suture.

3. Transposition of the Nerve.—This consists of freeing and removing a nerve from its normal or injured bed and placing it in a position which shortens its course and relaxes the nerve. By transposing the ulnar nerve from its position behind the internal condyle of the humerus to the cubital fossa, 3 to 5 cm. may be gained. Rerouting the median nerve from its deep position at the elbow to a superficial position may overcome a gap of 5 to 6 cm. The transposed nerve should be protected as well as possible and an atraumatic bed should be prepared for it. It is important not to sever or overstretch branches arising along its exposed course. This procedure is used to mobilize and relax a divided nerve and more commonly to remove a nerve from a course of irritation or constriction disturbing its normal function. A light or chronic trauma to the elbow has often resulted in a tardy ulnar palsy which is easily helped by the transposition of the ulnar nerve from the posterior to the anterior surface of the joint.

4. End to End Approximation.—End to end approximation is the ideal method of repairing a severed nerve; it gives the best functional results. The nerve ends should be freshened, the funicular pattern of the cross section of the proximal end approximated as accurately as possible to the pattern of the distal nerve end and very fine silk sutures on atraumatic needles placed in the epineurium alone of the approximated nerve segments. Deep sutures penetrating the nerve fascicles should be avoided under all circumstances. End to end suture is relatively simple in fresh wounds when the severed nerve ends are close together and can be approximated without tension. It may present considerable difficulty in older wounds when extensive neuromas must be

resected from each severed end to reach normal nerve tissue, when the nerve stumps are embedded in dense scar tissue often displaced from their normal position or when a large gap must be overcome. The technic of end to end suture will be described in more detail later. Recent experiments by Young and Medawar and Tarlov and Benjamin have shown that divided nerve ends can be approximated easily and satisfactorily with clotted plasma when no tension is present. This new method has also been successfully applied in man.

5. Stretching with Secondary End-to-End Suture.—This procedure is frequently employed in large, infected and old war wounds. It is rarely used in civilian practice. It consists of two operations. At the first operation the severed nerve segments are freed from the surrounding scar tissue and the proximal neuroma is sutured to the distal neuroma with strong silk or wire when it becomes evident that end to end approximation will not be possible and a large gap will be present after the nerve ends are freshened. This will keep the nerve segments from retracting further. If retraction has already taken place, relaxation of the nerve should be obtained by changing the position of the

nerve has been proved to be harmful, but gradual slow stretching does not seem to impair later regeneration. When the extremity has been fully extended, the second operation is performed. It consists of resection of the neuromas and scar tissue and end to end suture of the two severed nerve segments.

6. Transplantation of Nerve Grafts.—The transplantation of nerve grafts consists of interposing and suturing a segment of nerve between the ends of a divided nerve in order to bridge a large defect in its continuity. A nerve transplant may be autogenous when it is acquired from the patient himself or it may be homogenous when it is taken from another individual, or it may be heterogenous when it is obtained from an animal.

Recent experimental and clinical evidence has shown that the

autogenous grafts give more satisfactory functional results than homogenous grafts. Occasionally it is justifiable to sacrifice one nerve in an extremity to provide a graft for another, provided both are severely injured. However, this is rarely practicable and homogenous grafts must be more frequently employed as a more practical method of bridging large nerve defects. Homografts are available at all times and may be secured from freshly amputated extremities or from

fresh cadavers They should be removed under strict aseptic conditions within six hours after death and may be kept refrigerated in saline solution for twenty-four hours before being transplanted The necrotic changes which take place in the graft are removed and organized with the help of proliferating capillaries The changes in the nerve structure which ensue may delay and complicate nerve fiber regeneration and are probably the cause of imperfect functional result and delayed recovery It is advisable to re explore a graft three to four months after its transplantation in order to verify its structure, appearance and suture lines Some authors have advised resection followed by a new suture of the distal suture line of long grafts in order to remove an eventual neuroma and scar tissue which could keep the neuraxons from penetrating in the distal nerve segment This step does not seem necessary in short grafts

Cable grafts, still recommended by several authors, are made of many strands of small autogenous nerves They are not satisfactory because of the technical difficulties of suturing, the poor funicular apposition and the formation of large amounts of interneuronal scar tissue Stored grafts which have been fixed in formalin or alcohol are bound to be unsuccessful because they remain and act as fixed and dead material Heterogenous grafts have also been altogether unsuccessful and so has been the use of spinal cord or other organs employed for bridging nerve defects

7. Nerve to-Nerve Anastomosis—This method is applicable to only a very limited group of cases It consists of cutting a healthy but relatively unimportant nerve and suturing its central end to the distal segment of an important nerve that has been severely injured It is therefore necessary that the two nerves be of equal size and lie in close proximity to each other and that the function of the healthy sacrificed nerve is relatively unimportant as compared to the function of the injured nerve The best example of this usually successful method of repair is the hypoglossal facial nerve anastomosis, by which the distal segment of the injured facial nerve is sutured to the central segment of the sacrificed hypoglossal nerve

Other Methods.—Other methods of nerve repair are not successful and are often harmful to the normal nerves which have been either split or cut These methods known as suture a distance nerve flaps nerve implantation in another nerve and tubulization should never be attempted

Resection of bones is a rare procedure which might be necessary in combined and extensive nerve lesions in order to approximate nerves if grafts are not available or unsuccessfully used Tendon transfers may be of use in irreparable injuries involving the motor roots within the spinal canal or the avulsion of a portion of the brachial plexus or lumbosacral plexus

TECHNIC OF END TO END SUTURE

It is essential to have complete records of the patient's history and physical examination, and accurate reports and charts of the results of the motor, sensory, sympathetic and electrical examinations of the paralyzed extremity, the injured nerve and the areas involved by the peripheral nerve lesion. It is on the basis of these records only, that progress and regeneration can be detected and followed up after the nerve has been repaired. For this reason also, every patient operated upon for a peripheral nerve lesion should have check up examinations at regular intervals and the results of each examination should be charted and compared to those before the operation. This is the only way to evaluate the operative method employed and to determine the progress of regeneration.

Anesthesia—Operations on peripheral nerves are usually long and tedious. Complete muscular relaxation is required and must be maintained during the entire procedure. Usually long incisions and wide dissections are necessary and the handling of the nerve is usually painful. Local anesthesia is therefore least suitable and general anesthesia is to be preferred. Ether, avertin supplemented by nitrous oxide and oxygen, and sodium pentothal have all been used satisfactorily. The patients are given $\frac{1}{6}$ to $\frac{1}{4}$ grain of morphine and $\frac{1}{150}$ grain of atropine one hour before the start of the general anesthesia.

Position and Preparation of the Patient.—The position of the patient on the table is important. The patient should be placed on the back with the arm or leg to be operated on raised above and below the lesion and the extremity should be in such a position that the weakened nerve is exposed on an associated severed tendon. In draping the patient, allowances should be made for the same reasons.

A wide area of skin should always be prepared, in fact, in nerve lesions of the extremities it is well to prepare the entire extremity. The skin is first completely shaved, then thoroughly washed with soap and water and then sterilized with iodine and alcohol or ether and alcohol or ceepryn or other antiseptic solutions. The hand or foot is placed in a sterile stockinette or rubber glove or mitten made of transparent material such as phofilm, so as to permit observation of all the fingers and toes.

Exposure and Suture of the Nerve.—The incision should be outlined first by scratching the skin and should anticipate any necessary extension of the actual shorter incision made to expose the nerve lesion. The dissection should be carried between the muscle planes and cutting through a muscle belly should be avoided. Normal nerve above

the size of the nerve and the degree of tension, two to four heavier silk sutures (Deknatel 0000) are passed through the epineurium and tied loosely. They serve as guy sutures and will maintain the anatomic continuity and help rotate the nerve. Very fine silk sutures on atraumatic needles* are then passed in the epineurium between the guy sutures. The nerve is then rotated to one side and then to the other side by traction on the guy sutures until the epineurium is completely and accurately approximated in its entire circumference by the small sutures placed 1 to 2 mm apart. The sutures should never penetrate deeper than the epineurium, as any injury to the perineurium or the nerve fascicles will only result in increased fibrosis and greater disturbance in the already damaged paths of neuraxons.

There has always been considerable discussion as to the best material for nerve suture. The use of fine arterial or eye silk is entirely satisfactory. Silk is easily handled and mounted on an atraumatic needle, it produces very little damage to the epineurium. It can be tied with a very small knot and the reactions produced by it are minimal. Lately fine tantalum wire has been widely used. This wire is, however, more difficult to handle, it is more elastic and has a tendency to cut through the epineurium and has no other special advantages over fine silk.

Numerous substances have also been advocated for the protection of the suture line to prevent the infiltration of scar tissue into and about the suture line. However, experimental investigations have shown that the process of scar formation starts in the endoneural mesodermal tissue itself and may occasionally grow through the epineural suture into the tissues around the nerve. It has been claimed that the envelopment of the suture line and the proximal and distal nerve segments with a cuff of impermeable material, such as fascia, Cargile membrane, section of arteries or tantalum foil, will prevent the formation of a neuroma and prevent confusion of the nerve pattern at the suture line. A well prepared and accurately sutured nerve does not need protection. The result of the treatment is a gap in the nerve, a result of the treatment. It has also been demonstrated that confusion in the pathways of the neuraxons and neuroma formation may develop without continuity defect in the nerve as the result of a simple concussion or a small intraneural hemorrhage. It is fallacious to assume that an impermeable cuff such as tantalum foil should facilitate nerve regeneration. In many authors' opinion it is decidedly harmful as it interferes with the blood supply at the site of the suture and also produces a definite constricting fibroblastic reaction around the nerve.

* Anacap-braided eye silk 7-0

A technique of end to end approximation of a divided nerve by the use of a plasma clot has been described by T. A. J. The prepared nerve ends are treated autologous plasma polyphosphates in a few minutes holding this ingenious method is only possible when there is no tension at the site of union, that is in fresh injuries before the nerve segments have retracted and developed neuromas. It is particularly applicable for the repair of small nerves or the transplantation of nerve grafts.

The sutured nerve should be placed in an atraumatic bed, if possible between the fascia of two muscles, and after careful hemostasis the wound should be closed in layers with silk sutures. No drains should be placed in the wound. If relaxation of the nerve has been necessary by flexing or extending the extremity, a splint or plaster cast should be immediately applied and the extremity kept in that position for two to three weeks.

Repair of Partial Nerve Lesion—Occasionally a nerve may be only partially injured and contain both intact funiculi and severed funiculi with scar tissue. In such a case every effort should be made to preserve the uninjured fibers. After freeing the nerve from scar tissue, the epineurium should be opened a considerable distance in order to free the intact fibers from the scar tissue. It is very important to stimulate electrically the individual funiculi above the lesion before the nerve is sutured.

If the nerve is almost entirely divided it may be better to make complete section and do a direct end to end suture. Partial nerve suture usually results in a looping of the intact fibers which has no significance.

Repair of Intraneural Nerve Lesion Due to Intraneural Scar—

It is important to free first the nerve from the surrounding scar tissue which may compress and strangulate it and interfere with its function. This step known as *external neurolysis* should always be followed by electrical stimulation of the nerve above the site of trauma. Large dense neuromas should always be completely excised and the divided nerve repaired by end to end suture. In other cases it may be sufficient to open the epineurium and free the nerve fascicles from the scar tissue which might compress or distort them and thus decompress them. Resection of the intraneural scar or neuroma depends upon its aspect and also upon the degree of disability present.

POSTOPERATIVE CARE

The after treatment of patients who have had a peripheral nerve injury is equally as important as the operative procedure. In the majority of operations the extremity is placed in the position which is most favorable for the relaxation and suture of the injured nerve. This position should be maintained for at least two weeks until a good union of the divided nerve segments has occurred. From this time on gradual restoration of the normal position of the limb may be slowly carried out. The extremity is maintained in the desired position by a splint or plaster cast or hinged plaster splint which will permit gradual change in position. This splint should also support the paralyzed muscles and still allow movement of the fingers or toes. For example,

paralyzed muscles should not be overstretched and the overaction of antagonistic muscle groups should be regulated.

Physical therapy and particularly massage and passive movements will help later recovery of function by keeping the muscles in tone and the joints from becoming ankylosed. It is also important to keep the skin in good condition and avoid all pressure on the skin especially in the anesthetic areas. Pressure sores and trophic ulcers do not heal easily and may involve deeper layers, tendons and even bone. When motor paralysis begins to subside the patient should be encouraged to use the involved extremity as much as possible. He should persist in his efforts to use especially those muscles which were paralyzed and still are weak. Occupational therapy may help the treatment of residuals of paralysis and substitute the use of other muscles for the performance of certain motions which were previously done by hopelessly paralyzed or fibrotic muscles.

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TRIGEMINAL NEURALGIA: ITS RELIEF IN THE AGED AND FEEBLE

PAUL C. BUCY, M.D.*

TRIGEMINAL neuralgia is one of the most painful afflictions of man kind. When unrelieved it has led its victims to suicide. As the painful paroxysms are commonly precipitated by talking, eating and touching the face, it frequently causes its sufferers to become recluses avoiding human society in order to avoid speech, it causes them to lose weight through failure to eat and to become dirty and unkempt through failure to wash the hair, teeth and face. Relief is imperative if life is to be worthwhile. Many victims prefer death if the painful spasm cannot be relieved. Fortunately, complete relief is possible and it is important that no one be avoidably denied such relief.

The disease is readily recognized. It is characterized by sudden, brief paroxysms of sharp, twisting, burning pain in one side of the face. These attacks of pain are usually brought on by the peripheral stimulation mentioned above. The disease usually afflicts those in middle age or beyond. It often affects the aged. Although the disease often subsides temporarily and can be relieved for short periods by several medicinal agents, and for somewhat longer periods by alcoholic injections into the nerve, the only complete and permanent relief is achieved by section of the nerve proximal to the gasserian ganglion. This operation can be performed by a competent neurosurgeon upon almost any patient, and with relatively little risk. Yet patients are constantly being seen who have suffered unnecessary years of pain because someone said, "You are too old." "Your physical condition is too poor." "Your heart, or your lungs or your kidneys, or your diabetes contraindicates such an operation." "The operation would result in a paralysis of your face." Or, "It would cause you to lose your eyesight." *Fortunately, these opinions are largely erroneous, and these people can be relieved of their pain with a small risk, which almost all of them are willing to assume.* Let us examine these erroneous opinions in detail.

Frankly, in my opinion a patient is never too old for a retrogasserian neurotomy by the temporal approach. It is my present practice to operate upon all patients with trigeminal neuralgia in a semisitting position, under intravenous sodium pentothal anesthesia. The opera-

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tion requires thirty to sixty minutes (some operators perform it more quickly) The patients sit up in bed on the backrest immediately after the operation They are out of bed, occasionally on the first, almost

difficulty The following cases, although by no means instances of the oldest patients that have been operated upon anywhere, will illustrate that the advanced age of the patient is no barrier to operation I have heard of a patient of a neurosurgical colleague, who was operated upon at the age of 69 years My experience does not equal that.

ILLUSTRATIVE CASES

to work for some time because of the severe pain.

Examination revealed a rather obese man with an arterial hypertension of 104/00 and arteriosclerotic heart disease

On April 18, 1940, under ether anesthesia, and using the usual temporal approach, the lower three fourths of the right trigeminal nerve was divided back of the gasserian ganglion The motor root was spared The patient made an uneventful recovery and was soon discharged from the hospital He was completely

Neither advanced age nor arterial hypertension and cardiovascular disease prevented giving this man complete and lasting relief from this incapacitating pain As a result, he has returned to an active useful life

and strength

On admission, she weighed 67 pounds General physical examination revealed marked emaciation enfeeblement and dehydration The heart, lungs and blood pressure seemed to be in good condition.

On May 11 1939 the lower three fourths of the left trigeminal nerve was divided with the patient anesthetized with ether. The motor root was spared. She made a prompt recovery from the operation and was discharged six days later on May 17, entirely relieved of her pain and eating well. Within a short time she had regained weight to 130 pounds. She has since remained well and entirely free from pain.

could not have
ily willingly ac
e ensuing years
have fully justified our course of action

The following patient was likewise well along in years and in addition had recently sustained a fracture of the femur, had an arterial hypertension, cardiac disease and a secondary anemia. She, too, eagerly accepted the risk which operation carried with it and has been most grateful for the relief which her courage brought her.

CASE III—M. C. a widow aged 75 was admitted to the Chicago Memorial Hospital on June 9 1945 under the care of Dr. W. J. Schnute and her family physician Dr. Frederick Hoffman. On June 8 she had fallen and sustained an intertrochanteric fracture of the left femur. On June 13 Dr. Schnute performed an open reduction of the fracture using threaded wires and an intertrochanteric plate.

In addition she complained of recurring attacks of severe pain in the left side of the face involving the forehead, the region about the eye and the left cheek which had been present for many years. Because of this years time almost intolerable.

Examination revealed an elderly woman who was observed to suffer repeated attacks of severe pain in the left side of the face. There were however no objective changes in the head or neck. The blood pressure was 190/100. The heart was enlarged to the left anterior axillary line. She had an anemia of 3,390,000 red blood cells and 64% hemoglobin.

of the gasserian ganglion

On June 25 1945 using intravenous sodium pentothal for anesthesia the entire sensory root back of the gasserian ganglion was divided. Because of her anemia she was given a transfusion of 500 cc of citrated whole blood after the operation.

She was immediately relieved of her pain and has remained so. She made a prompt recovery from the operation and was able to be out of bed and up in a chair on June 28 three days after operation. She left the hospital on July 7, 1945 and could have left much sooner but for the condition of her hip.

It is obvious that when patients withstand section of the trigeminal nerve so well and recover as promptly as did the patients in Cases II and III a patient's condition must be poor indeed to justify denying them the relief which operation has to offer.

Patients suffering from this painful disease often suffer from severe cardiovascular disease. Even so, most of them withstand the operation well. In Cases I and III a fairly severe arterial hypertension was present. In the following case, an even more severe hypertension existed.

CASE V.—M. B., a housewife, 43 years of age, was referred by Drs. Alfred and

On examination, the principal abnormal findings were a blood pressure of 210/100 and an enlargement of the heart to the left.

On August 20, 1941, under ether anesthesia through the usual extradural temporal approach, the right trigeminal nerve back of the ganglion was divided. She made a prompt postoperative recovery and returned to her home on the seventh postoperative day. She has written every Christmas since and has referred numerous other sufferers. She has remained well and entirely free from pain.

For the

fore the operation

CASE VI.—J. H., a housewife aged 43, was referred by Drs. Hugh and Hedwig Kuhn of Hammond, Indiana. She was admitted to the Chicago Memorial Hospital on May 10, 1943, complaining of attacks of very severe stabbing burning pain in the right cheek and side of the nose during the preceding two and one-half years.

In 1930 during her eighth pregnancy she had developed a "high blood pressure" (200 mm. of mercury systolic). Since then it has always been elevated. There was no history of dyspnea, no cough or palpitation.

Examination by Dr. Richard Langendorf, our cardiologist, revealed a blood pressure of 200/138. The heart was enlarged to the left. It was regular, 82 beats per minute. There was a soft systolic apical murmur. An electrocardiogram revealed a left axis shift. Dr. Langendorf's diagnosis was "essential hypertension with moderate cardiac enlargement."

On May 12, 1943, under sodium pentothal anesthesia through the usual extra-

oral root was left intact.

Her blood pressure for the operation, completely relieved of all pain.

arterial hyper- and prostatic

CASE VI.—J. B., a "red cap" aged 60, was referred by Dr. J. P. Griffin of Chicago. He was admitted to the Chicago Memorial Hospital, June 3, 1945, complaining of recurring attacks of sharp shooting pains in the region of the right

lower jaw during the preceding three years. He was addicted to the use of considerable alcohol and suffered some from urinary frequency and urgency.

Examination revealed nothing unusual in the head or neck. His blood pressure was 190/100. The heart was enlarged to the left and there was a loud diastolic murmur at the base thought to be due to an aortic regurgitation. The liver was enlarged two fingerbreaths below the costal margin. The prostate was soft and moderately enlarged. The diagnosis was trigeminal neuralgia, arterial hypertension, arteriosclerotic heart disease and benign hypertrophy of the prostate.

On June 4 the patient was operated upon under intravenous sodium pentothal anesthesia. The lower three fourths of the sensory root back of the gasserian ganglion was divided. The motor root was spared.

He was able to sit on the edge of his bed on June 6, to be up in a chair on the 7th and to leave the hospital on June 9, the fifth postoperative day. He has continued well and entirely free from pain.

In the following case, severe rheumatic heart disease with mitral stenosis, auricular fibrillation and cerebral embolism confronted us. Again, complete and lasting relief from excruciating pain fully rewarded this woman's courage in electing to be operated upon.

CASE VII.—C. E., a housewife aged 59, was admitted to the Chicago Memorial Hospital on June 1, 1945.

She had suffered a stroke with paralysis of the left side of her body. This had almost completely subsided. Because of the precipitation of severe pain by eating, she has lost 60 pounds in weight in the ten months preceding her admission. She suffered from slight dyspnea on exertion. Her mother had died at 79 years of age of "dropsy" and her father at 80 of "heart trouble."

A FEW WEEKS

She left the hospital on November 14, seven days after operation. Thereafter she remained completely free of pain and relatively well until April 11, 1945, when she suffered a mild stroke. Later she developed pneumonia and died on July 23, 1945.

Both this patient and her family were very grateful for the complete relief from pain which she enjoyed during the almost three years of life that remained to her.

In the following case, arterial hypertension, myocardial degeneration, severe obesity and an enormous hernia complicated the picture. In spite of all these the patient withstood the operation well and remained free of pain for the rest of his life.

CASE VIII—J. E. M., a retired policeman aged 65 was referred by Dr. Peter S. Clark. He was complaining of paroxysms of severe pain in the right upper lip and cheek of over ten years' duration.

1000 2500 3000 4000 5000 6000 7000 8000 9000 10000 11000 12000 13000 14000 15000 16000 17000 18000 19000 20000 21000 22000 23000 24000 25000 26000 27000 28000 29000 30000 31000 32000 33000 34000 35000 36000 37000 38000 39000 40000 41000 42000 43000 44000 45000 46000 47000 48000 49000 50000 51000 52000 53000 54000 55000 56000 57000 58000 59000 60000 61000 62000 63000 64000 65000 66000 67000 68000 69000 70000 71000 72000 73000 74000 75000 76000 77000 78000 79000 80000 81000 82000 83000 84000 85000 86000 87000 88000 89000 90000 91000 92000 93000 94000 95000 96000 97000 98000 99000 100000

On January 16, 1942, under ether anesthesia through the usual extradural temporal approach the lower three fourths of the sensory root back of the gasserian ganglion was divided. The motor root was spared.

The patient made a prompt postoperative recovery and remained entirely free from pain until his death from coronary thrombosis on December 25, 1944.

Severe pulmonary disease is also not a definite barrier to relieving these patients. The situation outlined in the following case history first led me to the use of intravenous sodium pentothal for anesthesia in these cases. It proved so satisfactory that I have adopted it for use in all cases since that time. After having used local anesthesia, avertin, ethylene and ether on many other occasions, I am convinced that intravenous sodium pentothal is the most satisfactory for this operation.

1000 2500 3000 4000 5000 6000 7000 8000 9000 10000 11000 12000 13000 14000 15000 16000 17000 18000 19000 20000 21000 22000 23000 24000 25000 26000 27000 28000 29000 30000 31000 32000 33000 34000 35000 36000 37000 38000 39000 40000 41000 42000 43000 44000 45000 46000 47000 48000 49000 50000 51000 52000 53000 54000 55000 56000 57000 58000 59000 60000 61000 62000 63000 64000 65000 66000 67000 68000 69000 70000 71000 72000 73000 74000 75000 76000 77000 78000 79000 80000 81000 82000 83000 84000 85000 86000 87000 88000 89000 90000 91000 92000 93000 94000 95000 96000 97000 98000 99000 100000

Occasionally diabetes mellitus and trigeminal neuralgia will be combined in the same patient. However, with proper medical management, the presence of the diabetes should interfere little if any with the surgical relief of the neuralgia.

CASE X.—M. L. L., a retired man aged 68, was referred by Dr. M. P. Rogers

sure was 138/74. There was no demonstrable retinal or peripheral arteriosclerosis. The

the ganglion sparing the motor root. Two days after the operation on April 15 he was up out of bed and on the fourth postoperative day April 17, he returned home. The lower part of his face was anesthetic and he was entirely free from pain.

COMMENT

The mortality from retrogasserian neurotomy by the temporal approach is not over 0.5 per cent (Peet¹). This is particularly noteworthy when one recalls that we are dealing with a disease of the latter decades of life. The average age at onset of the disease is 51 years and at the time of operation is several years greater. Furthermore, many of these patients are suffering from one or more of the degenerative diseases so common in the age group: myocardial degeneration, arteriosclerosis, arterial hypertension, chronic nephritis or diabetes. Thus very low mortality figure is the best proof of the fact that age and debilitating disease are seldom contraindications to the surgical relief from this painful condition.

Does the operation result in a paralysis of the face? In the main, no. The operation results in a loss of feeling in the denervated part of the face, but usually there is no change in the mobility or in the appearance of the face. At times, however, the operation is followed by a facial paralysis, as in Case VII of this series. Grant,² in a study of a large series of 925 cases, found an incidence of 4 per cent of postoperative facial paralysis. In only six cases or 0.65 per cent, however, was the paralysis permanent. Peet,¹ who has had an extensive experience, says that such paralysis occurs in 2 per cent of the cases. Fortunately, as Peet notes, the paralysis almost always completely subsides in a few weeks. That has likewise been my experience.

Does the operation endanger the eye? In the majority of cases the pain involves only the maxillary and mandibular divisions of the nerve.

In those cases only the lower three fourths of the nerve need be divided, thus sparing the fibers to the ophthalmic division and to the eye. In these cases the eye is in no way endangered. In a few cases

rough foreign body should enter the eye, it might erode the cornea and lead to ulceration and infection. This can be obviated by the following simple procedures. First, the eye should be washed night and morning using an eyecup and saturated boric acid solution. This serves to remove dirt and keep the eye clean. Second, the anesthetic eye should never be rubbed or scratched. Third, when out-of-doors a special shield, sometimes known as a Schroeder eyecup, should be worn. It is transparent and attached to the rim of the glasses and serves like a goggle to keep foreign particles out of the eye. This shield must be

and denude the anesthetic cornea should the eye come open. In view of the complete loss of feeling this might well happen without the

material so that the eye can be seen at all times. This air tight shield will keep the eye, particularly the cornea, moist and thus hasten healing. The air tight shield should be left in place until all ulcerated or denuded areas of the cornea have completely healed. Fortunately ulceration of the cornea is uncommon and thus such treatment is rarely needed.

The obsolete operation of extirpation of the gasserian ganglion and

neurotomy used in the cases presented here

SUMMARY

In an endeavor to aid in relieving the elderly and enfeebled of the excruciating pain of trigeminal neuralgia it has been pointed out, with

suitable illustrative cases, that advanced age, enfeeblement, the diseases to which the aged are subject, such as cardiac disease, arterial hypertension, diabetes fracture of the hip and pulmonary disease, are seldom barriers to the permanent relief of the pain of trigeminal neuralgia by retrogasserian neurotomy. The fears of postoperative facial paralysis and the loss of the eye, though having some slight basis in fact are so slightly justified that they do not warrant the avoidance of surgical relief.

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SYMPATHECTOMY IN PERIPHERAL VASCULAR DISEASE AND HYPERTENSION

HAROLD C. VORIS, Ph D, M D, F.A.C.S.*

THE surgery of the sympathetic nervous system is a development of the twentieth century. Although Alexander⁶ first performed sympathectomy for epilepsy in 1889 and Jaboulay¹⁸ reported the use of perarterial sympathectomy in 1899, it was not until after the turn of the century that surgeons began to take advantage of the gradual accumulation of knowledge of the function and structure of the sympathetic

increase in anatomic and physiologic knowledge and the accumulation of critical case reports have placed the surgery of the sympathetic nervous system on a sound clinical basis. In many conditions sympathectomy has been tried and found wanting and even yet wide differences of opinion exist about the scope of its usefulness. However, the greatest clinical experience with surgical extirpations of the sympathetic nervous system has been in peripheral vascular disease and in hypertension. This paper concerns itself with its use in these fields.

PERIPHERAL VASCULAR DISEASE

Leriche²⁰ in 1913 described the increase in blood flow to the extremities produced by perarterial sympathectomy. In 1924 Hunter¹⁷ and Royal²⁸ advocated sectioning the sympathetic ramus for the excessive muscle tone in spastic states. Their visit to this country was responsible for the initiation of surgical interest in America in the sympathetic nervous system. These investigators had noted a coincident vasomotor paralysis in their cases after operation. In 1925 Adson¹ reported the use of lumbar sympathectomy in Raynaud's disease. From this point on there was rapid progress in the application of sympathectomy to peripheral vascular disease and in the development of more complete methods of sympathetic denervations.

The development of special methods of investigation of patients suffering from peripheral vascular disease has paralleled the clinical application of sympathectomy and the technical improvements in surgical procedure. These are fully described by Allen, Barker and Hines.⁸

The most generally useful of these methods is skin temperature

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studies of the effects of vasodilation as induced by external heat, local or spinal anesthesia. This method has its pitfalls, however, and cannot be depended upon unless correlated with careful clinical observation. As Allen, Barker and Hines³ point out, a knowledge of the symptoms of peripheral vascular disease, of the methods of examining patients with peripheral vascular disease and the differential diagnosis of peripheral vascular disease is more important in the prognosis and evaluation of patients for possible sympathectomy than any single special method of study.

Raynaud's Disease.—Raynaud's disease represents on the one hand an early and spectacular accomplishment with sympathectomy and on the other a great disappointment. As is well known, there are two schools of thought regarding the nature of Raynaud's disease. One school holds with Raynaud's original thesis, that the cause is a *neurosis with overstimulation of the vasoconstrictor fibers to the small blood vessels*. They admit that, in cases of long standing, definite pathological changes are seen in the digital vessels in the nature of obliterative endarteritis, but in their view this is only true in advanced cases and represents an end stage in the disease. Sir Thomas Lewis and his co-workers advanced a radically different theory of etiology. Lewis concluded that there is a local fault in the digital arteries with increased susceptibility to cold and that vasomotor activity is normal. At present the weight of evidence seems to favor the original conception of Raynaud, but Lewis must be given credit for recognizing that organic changes in the digital arteries may occur fairly early and for emphasizing the important role of cold in precipitating the clinical attacks.

If Raynaud's theory of etiology is correct sympathectomy is the ideal treatment and should result in cure unless the disease is so far advanced that serious obliterative changes have taken place in the digital arteries or unless it is associated with scleroderma. Actually the results often leave much to be desired. Allen, Barker and Hines³ recently

... the ... of the upper ex

other hand these authors state—and there is general agreement in the literature—that the results in the lower extremities are usually good. Because of the relative rarity of the syndrome in the lower extremities this fact is sometimes lost sight of in discussion.

There are two views of the cause of the uniformly good results in the lower extremities and the frequent failure in the upper extremities. One view maintained by Adson² and his associates is that sympathectomy is technically more complete and regeneration less likely for the

lower extremities than for the upper or that the disease and its trophic changes are not as severe in the lower extremities. They do not believe that any anatomic variation in the type of sympathectomy is responsible for the differences noted.

On the other hand White and Smithwick²⁷ believe that the difference is due to the type of ganglionectomy ordinarily performed. They point out that the usual operation for sympathetic denervation of the upper extremity, *viz.* resection of the stellate ganglion is a postganglionic denervation while lumbar sympathectomy is a preganglionic procedure. They cite clinical and experimental investigations to show the sensitization of arteries denervated by postganglionic procedures to physiologic dilutions of adrenalin. Consequently they have developed a technic of preganglionic sympathectomy (section of the dorsal sympathetic trunk below the third thoracic ganglion and intrathecal section of the second and third intercostal nerves for the upper extremity and resection of the first, second and third lumbar ganglia for the lower) which they claim to give superior results to postganglionic (cervicothoracic) sympathectomy. These authors emphasize the need for taking precaution against regeneration of sympathetic fibers and feel that this may often be the explanation for the recurrence of symptoms.

Kuntz and Dillon¹⁹ have criticized the procedure of Smithwick and White and presented evidence that the first thoracic nerve contains preganglionic components. They maintain that sympathectomy of the upper extremity should include removal of the first thoracic ganglion and its rami. The role of the first thoracic segment in the sympathetic innervation of the upper extremities is still disputed.

The actual approach used varies with different authors for both upper and lower extremities. Adson⁶ for example uses a midline posterior approach through the first rib for cervicodorsal sympathectomy and an anterior transperitoneal approach for lumbar sympathectomy. This permits bilateral sympathectomy in one stage for either the upper or lower extremities.

White and Smithwick²⁷ on the other hand use a paravertebral posterior approach for denervation of the upper extremities, resecting the third rib and a posterior retroperitoneal approach for lumbar ganglionectomy. Sympathectomy for both extremities either upper or lower is done in two stages, one for each side.

Other operators for example Ochsner and DeBakey²⁸ favor the anterior approach to the cervicodorsal ganglia and upper sympathetic trunk. The technic of this procedure has also been described by White²⁸. It requires a two stage operation for bilateral denervation of the upper extremities.

CASE I—M. H. a 23 year old white woman, a bookkeeper in an automobile service station, complained of coldness of the hands and feet and swelling of the feet for the preceding eighteen months. The condition was much worse during the

winter months. Characteristic phasic color changes of the fingers and toes were described, consisting of blueness, followed by marked redness. During the first stage there was subjective numbness, during the second, pain. Her feet gave her much more discomfort than her hands. She stated that she could keep her hands

TABLE 1 (CASE 1) —EFFECT OF ORAL INGESTION OF ALCOHOL (WHISKY) ON SKIN TEMPERATURES OF EXTREMITIES

	Digit	Feet		Hands	
		Right	Left	Right	Left
Basal skin temperature	1	26.7° C	25.4° C	27.7° C	27.2° C
	2	25.3° C	25.3° C	28.4° C	28.1° C
	3	25.3° C	25.1° C	26.7° C	27.2° C
	4	25.2° C	25.2° C	26.2° C	26.7° C
	5	25.3° C	25.1° C	25.9° C	26.4° C
Skin temperature 45 minutes after 45 cc of whiskey orally	1	29.1° C	29.3° C	31.9° C	33.2° C
	2	27.1° C	26.7° C	32.2° C	33.7° C
	3	26.7° C	26.1° C	32.3° C	33.9° C
	4	25.9° C	26.1° C	32.7° C	31.3° C
	5	25.9° C	26.1° C	32.2° C	31.1° C

Room Temperature 80° F

TABLE 2 (CASE 1) —EFFECT OF SPINAL ANESTHESIA ON SKIN TEMPERATURES IN THE LOWER EXTREMITIES

	Digit	Feet		Hands	
		Right	Left	Right	Left
Basal skin temperature	1	25.2° C	25.1° C	25.8° C	25.1° C
	2	24.5° C	24.6° C	24.9° C	25.2° C
	3	24.6° C	24.8° C	25.0° C	25.0° C
	4	24.8° C	24.8° C	25.1° C	24.9° C
	5	25.0° C	25.1° C	24.6° C	25.1° C
Skin temperatures after intraspinal injection of 150 mg of procaine	1	31.7° C	33.7° C	28.9° C	28.0° C
	2	32.4° C	33.9° C	28.7° C	28.1° C
	3	32.2° C	33.7° C	28.2° C	27.9° C
	4	32.4° C	34.2° C	28.3° C	27.4° C
	5	33.7° C	34.3° C	27.2° C	27.2° C

Room Temperature 78° F

Table 1 shows the effect of the ingestion of alcohol (whiskey) on the peripheral circulation. Because of the relatively poor response obtained with alcohol in the lower extremities the patient was given a spinal anesthetic. Under spinal anesthesia there was an average rise of 8° to 7° C in the temperature of the toes (Table 2)

TABLE 3 (CASE 1)—SKIN TEMPERATURES OF DIGITS NINE DAYS AFTER BILATERAL LUMBAR SYMPATHECTOMY

Digit	Feet		Hands	
	Right	Left	Right	Left
1	32.5° C	32.9° C	32.5° C	33.5° C
2	32.7° C	32.9° C	31.5° C	32.5° C
3	32.8° C	33.0° C	31.0° C	32.5° C
4	33.0° C	33.5° C	30.9° C	32.3° C
5	33.7° C	33.7° C	31.0° C	31.8° C

Room Temperature 78° F

TABLE 4 (CASE 1)—INDUCTION OF REFLEX PERIPHERAL VASOSPASM BY IMMERSION OF ONE EXTREMITY IN ICE WATER. NOTE THE EFFECT ON THE UNDENERVATED RIGHT UPPER EXTREMITY AND THE LACK OF EFFECT ON THE DENERVATED LOWER EXTREMITIES 19 DAYS AFTER BILATERAL LUMBAR SYMPATHECTOMY

	Digit	Feet		Hands	
		Right	Left	Right	Left
Basal skin temperature	1	31.8° C	33.3° C	35.2° C	34.8° C
	2	34.2° C	31.3° C	34.3° C	34.5° C
	3	34.3° C	33.3° C	33.7° C	34.4° C
	4	34.7° C	33.7° C	33.6° C	33.5° C
	5	34.4° C	34.8° C	32.9° C	33.8° C
Skin temperature after immersion of left upper extremity below the elbow for ten minutes in water at 0° C	1	31.0° C	35.2° C	28.8° C	
	2	34.3° C	34.5° C	29.3° C	
	3	34.3° C	34.3° C	29.0° C	
	4	34.9° C	34.8° C	28.8° C	
	5	35.2° C	34.4° C	27.8° C	

Room Temperature 78° F

The diagnosis of Raynaud's disease involving all four extremities but worse in the lower was made, and bilateral lumbar sympathectomy was advised.

On May 16 1942 bilateral transperitoneal lumbar sympathectomy was carried out. The lumbar sympathetic chain was removed on both sides including the second third and fourth lumbar ganglia with the intervening trunks. The patient made an uneventful convalescence from this procedure and was dismissed from the

winter months. Characteristic phasic color changes of the fingers and toes were described, consisting of blueness, followed by marked redness. During the first stage there was subjective numbness, during the second pain. Her feet gave her much more discomfort than her hands. She stated that she could keep her hands

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	Digit	Feet		Hands	
		Right	Left	Right	Left
Basal skin temperature	1	26.7° C.	25.4° C.	27.7° C.	27.2° C.
	2	25.3° C.	25.3° C.	28.4° C.	28.4° C.
	3	25.3° C.	25.1° C.	26.7° C.	27.2° C.
	4	25.2° C.	25.2° C.	26.2° C.	26.7° C.
	5	25.3° C.	25.1° C.	25.9° C.	26.4° C.
Skin temperature 45 minutes after 45 cc of whiskey orally	1	29.1° C.	29.3° C.	31.9° C.	33.2° C.
	2	27.1° C.	26.7° C.	32.2° C.	33.7° C.
	3	26.7° C.	26.1° C.	32.3° C.	33.9° C.
	4	25.9° C.	26.1° C.	32.7° C.	34.3° C.
	5	25.9° C.	26.1° C.	32.2° C.	34.1° C.

Room Temperature 80° F

TABLE 2 (CASE 1) —EFFECT OF SPINAL ANESTHESIA ON SKIN TEMPERATURES IN THE LOWER EXTREMITIES

	Digit	Feet		Hands	
		Right	Left	Right	Left
Basal skin temperature	1	25.2° C.	25.1° C.	25.8° C.	25.1° C.
	2	24.5° C.	24.6° C.	24.9° C.	25.2° C.
	3	24.6° C.	24.8° C.	25.0° C.	25.0° C.
	4	24.8° C.	24.8° C.	25.1° C.	24.9° C.
	5	25.0° C.	25.1° C.	24.6° C.	25.1° C.
Skin temperatures after intraspinal injection of 150 mg of procaine	1	31.7° C.	33.7° C.	28.9° C.	28.0° C.
	2	32.4° C.	33.9° C.	28.7° C.	28.1° C.
	3	32.2° C.	33.7° C.	28.2° C.	27.9° C.
	4	32.4° C.	34.2° C.	28.3° C.	27.4° C.
	5	33.7° C.	34.3° C.	27.2° C.	27.2° C.

Room Temperature, 78° F

fairly warm while at work in the winter time but that because of cold drafts her feet suffered greatly even with woolen stockings and heavy shoes.

and a well developed young woman whose fingers and toes

Table 1 shows the effect of the ingestion of alcohol (whiskey) on the peripheral circulation. Because of the relatively poor response obtained with alcohol in the lower extremities the patient was given a spinal anesthetic. Under spinal anesthesia there was an average rise of 6° to 7° C in the temperature of the toes (Table 2).

TABLE 3 (CASE I) —SKIN TEMPERATURES OF DIGITS NINE DAYS AFTER BILATERAL LUMBAR SYMPATHECTOMY

Digit	Feet		Hands	
	Right	Left	Right	Left
1	32.5° C	32.9° C	32.5° C	33.5° C
2	32.7° C	32.9° C	31.5° C	32.5° C
3	32.8° C	33.0° C	31.0° C	32.5° C
4	33.0° C	33.5° C	30.9° C	32.3° C
5	33.7° C	33.7° C	31.0° C	31.8° C

Room Temperature 73° F

TABLE 4 (CASE I) —INDUCTION OF REFLEX PERIPHERAL VASOSPASM BY IMMERSION OF ONE EXTREMITY IN ICE WATER. NOTE THE EFFECT ON THE UNDENERVATED RIGHT UPPER EXTREMITY AND THE LACK OF EFFECT ON THE DENERVATED LOWER EXTREMITIES 19 DAYS AFTER BILATERAL LUMBAR SYMPATHECTOMY

	Digit	Feet		Hands	
		Right	Left	Right	Left
Basal skin temperature	1	34.8° C	33.3° C	35.2° C	34.8° C
	2	34.2° C	33.3° C	34.3° C	34.5° C
	3	34.3° C	33.3° C	33.7° C	34.4° C
	4	34.7° C	33.7° C	33.6° C	33.5° C
	5	34.4° C	34.8° C	32.9° C	33.8° C
Skin temperature after immersion of left upper extremity below the elbow for ten minutes in water at 0° C	1	34.0° C	35.2° C	28.8° C	
	2	34.3° C	34.5° C	29.3° C	
	3	34.3° C	34.3° C	29.0° C	
	4	34.9° C	34.8° C	28.8° C	
	5	35.2° C	34.4° C	27.8° C	

Room Temperature 73° F

The diagnosis of Raynaud's disease involving all four extremities but worse in the lower was made and bilateral lumbar sympathectomy was advised.

On May 16 1942 bilateral transperitoneal lumbar sympathectomy was carried out. The lumbar sympathetic chain was removed on both sides including the second third and fourth lumbar ganglia with the intervening trunks. The patient made an uneventful convalescence from this procedure and was dismissed from the

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	Digit	Feet		Hands	
		Right	Left	Right	Left
Basal skin temperature	1	26.7° C.	25.4° C.	27.7° C.	27.2° C.
	2	25.3° C.	25.3° C.	28.4° C.	28.4° C.
	3	25.3° C.	25.1° C.	26.7° C.	27.2° C.
	4	25.2° C.	25.2° C.	26.2° C.	26.7° C.
	5	25.3° C.	25.1° C.	25.9° C.	26.4° C.
Skin temperature 45 minutes after 43 cc of whiskey orally	1	29.1° C.	29.3° C.	31.9° C.	33.2° C.
	2	27.1° C.	26.7° C.	32.2° C.	33.7° C.
	3	26.7° C.	26.1° C.	32.3° C.	33.9° C.
	4	25.9° C.	26.1° C.	32.7° C.	34.3° C.
	5	25.9° C.	26.1° C.	32.2° C.	31.1° C.

Room Temperature 80° F

TABLE 2 (CASE 1) —EFFECT OF SPINAL ANESTHESIA ON SKIN TEMPERATURES IN THE LOWER EXTREMITIES

	Digit	Feet		Hands	
		Right	Left	Right	Left
Basal skin temperature	1	25.2° C.	25.1° C.	25.8° C.	25.1° C.
	2	24.5° C.	24.6° C.	24.9° C.	25.2° C.
	3	24.6° C.	24.8° C.	25.0° C.	25.0° C.
	4	24.8° C.	24.8° C.	25.1° C.	24.9° C.
	5	25.0° C.	25.1° C.	24.6° C.	25.1° C.
Skin temperatures after intraspinal injection of 150 mg of procaine	1	31.7° C.	33.7° C.	28.9° C.	28.0° C.
	2	32.4° C.	33.9° C.	28.7° C.	28.1° C.
	3	32.2° C.	33.7° C.	28.2° C.	27.9° C.
	4	32.4° C.	31.2° C.	28.3° C.	27.4° C.
	5	33.7° C.	34.3° C.	27.2° C.	27.2° C.

Room Temperature 78° F

Table 1 shows the effect of the ingestion of alcohol (whiskey) on the peripheral circulation. Because of the relatively poor response obtained with alcohol in the lower extremities the patient was given a spinal anesthetic. Under spinal anesthesia there was an average rise of 6° to 7° C in the temperature of the toes (Table 2)

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2	32.7° C	32.9° C	31.5° C	32.5° C
3	32.8° C	33.0° C	31.0° C	32.5° C
4	33.0° C	33.5° C	30.9° C	32.3° C
5	33.7° C	33.7° C	31.0° C	31.8° C

Room Temperature 78° F

TABLE 4 (CASE 1) —INDUCTION OF REFLEX PERIPHERAL VASOSPASM BY IMMERSION OF ONE EXTREMITY IN ICE WATER. NOTE THE EFFECT ON THE UNDENERVATED RIGHT UPPER EXTREMITY AND THE LACK OF EFFECT ON THE DENERVATED LOWER EXTREMITIES 19 DAYS AFTER BILATERAL LUMBAR SYMPATHECTOMY

	Digit	Feet		Hands	
		Right	Left	Right	Left
Basal skin temperature	1	34.8° C	33.3° C	35.2° C	34.8° C
	2	34.2° C	33.3° C	34.3° C	34.5° C
	3	34.3° C	33.3° C	33.7° C	34.4° C
	4	34.7° C	33.7° C	33.6° C	33.5° C
	5	34.4° C	34.8° C	32.9° C	33.8° C
Skin temperature after immersion of left upper extremity below the elbow for ten minutes in water at 0° C	1	34.0° C	35.2° C	28.8° C	
	2	34.3° C	34.5° C	29.3° C	
	3	34.3° C	34.3° C	29.0° C	
	4	34.9° C	34.8° C	28.8° C	
	5	35.2° C	34.4° C	27.8° C	

Room Temperature 78° F

The diagnosis of Raynaud's disease was made in the lower

On May 1
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second third

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	Digit	Feet		Hands	
		Right	Left	Right	Left
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	2	25.3° C.	25.3° C.	28.4° C.	28.4° C.
	3	25.3° C.	25.1° C.	26.7° C.	27.2° C.
	4	25.2° C.	25.2° C.	26.2° C.	26.7° C.
	5	25.3° C.	25.1° C.	25.9° C.	26.4° C.
Skin temperature 45 minutes after 43 cc. of whiskey orally	1	29.1° C.	29.3° C.	31.9° C.	33.2° C.
	2	27.1° C.	26.7° C.	32.2° C.	33.7° C.
	3	26.7° C.	26.4° C.	32.3° C.	33.9° C.
	4	25.9° C.	26.1° C.	32.7° C.	34.3° C.
	5	25.9° C.	26.1° C.	32.2° C.	34.1° C.

Room Temperature 80° F

TABLE 2 (CASE 1) —EFFECT OF SPINAL ANESTHESIA ON SKIN TEMPERATURES IN THE LOWER EXTREMITIES

	Digit	Feet		Hands	
		Right	Left	Right	Left
Basal skin temperature	1	25.2° C.	25.1° C.	25.8° C.	25.1° C.
	2	24.5° C.	24.6° C.	24.9° C.	25.2° C.
	3	24.6° C.	24.8° C.	25.0° C.	25.0° C.
	4	24.8° C.	24.8° C.	25.1° C.	24.9° C.
	5	25.0° C.	25.1° C.	24.6° C.	25.1° C.
Skin temperatures after intraspinal injection of 150 mg. of procaine	1	31.7° C.	33.7° C.	28.9° C.	28.0° C.
	2	32.4° C.	33.9° C.	28.7° C.	28.1° C.
	3	32.2° C.	33.7° C.	28.2° C.	27.9° C.
	4	32.4° C.	34.2° C.	28.3° C.	27.4° C.
	5	33.7° C.	34.3° C.	27.2° C.	27.2° C.

Room Temperature 78° F

calf muscles. The knee jerks were equal, the right ankle jerk could not be obtained. The right foot and leg were cold and clammy with excessive perspiration below the knee.

Right lumbar sympathectomy was advised. This was carried out on June 5, 1945, through a right unilateral retroperitoneal approach as described by White and Smithwick.²⁷ The right first, second and third lumbar ganglia were resected with the intervening trunk. The patient made an uneventful convalescence and left the hospital on the seventh postoperative day. Table 5 shows the skin temperature of the extremities on the day of dismissal.

The child was recently examined fourteen months after operation. The right lower extremity was 3 cm. shorter than the left. The right leg was now only 2 cm. shorter than the left. The right leg instead of being 3 cm. shorter than the left was now only 2 cm. shorter.

The result seems all that was expected and well worthwhile from the standpoint of subjective improvement. To date no significant effect on growth has taken place.

Chronic ulcerations or localized gangrene with associated vasoconstriction may at times respond favorably to sympathectomy.

CASE III—P. B., a 42 year old machinist, had suffered frostbite of both feet three years before. The feet had recovered without any gangrene but pain and swelling of the toes, particularly the left great toe, persisted. A year later an ulceration appeared on the plantar surface of the distal phalanx of the left great toe. This ulceration had occasionally healed for short periods of time but was usually present. After a year the toe had been operated on because of osteomyelitis. The operative wound healed slowly and then soon broke open. It had continued to drain.

Six months before he was seen a similar ulcer appeared on the plantar surface of the right great toe and had persisted.

factory in the posterior tibial and dorsal pedis arteries and on both sides. The

factory in the posterior tibial and dorsal pedis arteries and on both sides. The

Thromboangitis Obliterans and Arteriosclerosis Obliterans.—The use of sympathectomy in properly selected cases of vaso-occlusive disease has been debated for many years. Adson and Brown⁴ and their co-workers at the Mayo Clinic have advocated the use of sympathectomy in certain cases of thromboangitis obliterans (Buerger's disease).

hospital thirteen days after operation Table 3 shows the skin temperatures on the ninth day after operation At that time both the hands and feet were warm. The feet were dry, the hands perspiring

Four years have passed since The feet have remained warm during the winter months increased, in the hands of the child. Since leaving her former occupation she is much less exposed to cold in the winter months

Vasospasm Associated With Miscellaneous Conditions.—Sympathectomy has been widely used in cases of vasospasm associated with other diseases Many patients with *anterior poliomyelitis* com-

TABLE 5 (CASE II)—SKIN TEMPERATURES OF EXTREMITIES SEVEN DAYS AFTER RIGHT UNILATERAL LUMBAR SYMPATHECTOMY

Digit	Feet		Hands	
	Right	Left	Right	Left
1	33.0° C	26.0° C	27.6° C	28.3° C
2	31.0° C	26.0° C	28.7° C	27.5° C
3	31.5° C	25.9° C	28.1° C	27.2° C
4	31.5° C	25.5° C	27.5° C	27.0° C
5	31.1° C	25.6° C	27.3° C	27.0° C

Room Temperature 71° F

plaint of coldness and discoloration of the affected limbs These manifestations can often be shown to be of vasospastic origin and if this is

worthwhile in selected cases

CASE II—N. N., a 12 year old girl, had suffered an attack of anterior poly-

hands were warm and dry. There was no residual deformity except flattening of the tip of the left fifth finger.

A year later the patient's wife wrote that he was doing heavy mechanical and welding work and was having no trouble with his hands. Sympathectomy was well worth while in this case. The improvement the patient had noted in his lower extremities after sympathectomy had convinced him of its desirability and he came requesting the same procedure on his upper limbs.

HYPERTENSION

The treatment of hypertension by some surgical procedure designed to interrupt sympathetic pathways to large areas of the vascular bed began in 1930 when Adson⁵ treated a case by bilateral anterior rhizotomy of the sixth thoracic to second lumbar roots inclusive. Craig⁹ first performed a subdiaphragmatic splanchnicectomy in 1932. Peet²⁴ in 1933 began his series of over 1500 cases in which splanchnicectomy and lower dorsal sympathectomy is performed through a supradiaphragmatic approach. Crile¹⁰ advocated celiac ganglionectomy and carried out this operation in a large series of cases. Smithwick⁷ developed a combined supra and infradiaphragmatic approach which permits an extensive thoracolumbar sympathectomy (D9 to L2 ganglia) and an even higher resection of the splanchnic trunks from the level of the eighth rib down to the celiac ganglia. The approaches of both Adson⁵ and Smithwick⁷ permit the inspection of adrenal and kidney. Recently Grimson^{12, 13, 14} and his co-workers have studied the effects of sympathectomy in hypertension both experimentally and clinically. This author states that the value of sympathectomy in this condition is di-

chain and at times the upper two lumbar ganglia. This is obviously a more extensive and dangerous procedure than any of the other types of sympathectomy but is by far the most complete at times being total. Clinically this procedure has not been used in a sufficiently large number of cases to permit its comparison with the procedures of Adson⁵, Peet²⁴ and Smithwick.⁷

There are many causes of hypertension in man and it is associated with many diseases. Page³ classifies and lists the various causes under

other causes must be excluded in so far as possible by careful diagnostic study before the diagnosis of essential hypertension can be made. This is the largest group however and it and its late complications are one of the most important causes of death.

The selection of cases for operation is agreed by all to be of the

Allen, Barker and Hines state that the most suitable cases are patients with the slowly progressive type of the disease and mild to moderate degrees of rest pain or minor ulcers or gangrene. They use the vasomotor index as a preoperative test and state that if the skin temperature of the digits in the affected extremity or extremities rises to 30° C or more after the administration of intravenous typhoid vaccine the response to sympathectomy will usually be good. These authors feel that sympathectomy is much less useful in peripheral arteriosclerosis obliterans and recommend it in only a small group of patients.

DeTakats, Fowler, Jordan and Husley¹² have recently recommended a more liberal use of sympathectomy in peripheral arteriosclerosis. They state that the indications are popliteal, femoral or aortic occlu-

reported seven sympathectomies on patients over 60 years of age. They also use sympathectomy in patients with or without diabetes whose chief complaint is continuous intractable burning pain associated with osteoporosis, who receive relief from diagnostic paravertebral block and who otherwise would require supracondylar amputation.

CASE IV—P. V., a 43 year old French Canadian welder, began eight years

with procaine

...mities was made
carried out on
first rib on each
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time of dismissal
han the feet. The

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The selection of cases for operation is agreed by all to be of the

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ability to concen

diastolic If it does not fall below 160 mm systolic and 110 mm diastolic the likelihood of significant benefit is poor The response to sodium amytal by mouth is also significant, particularly the diastolic level If the diastolic level does not fall below 100 after the administration of sodium amytal (12 grams in two doses of 6 grams each, two hours apart) the prognosis is poor for a good operative result The intravenous administration of 15 grains of sodium pentothal has also been much used as a preoperative test but seems to have no advantage over sodium amytal by mouth Russek, Southworth and Zohman²⁸ have recently used continuous caudal anesthesia as a test in the selection of patients with hypertension for sympathectomy As DeTakats¹¹ has pointed out, high spinal anesthesia or paravertebral sympathetic block cannot be considered as good tests for operability of patients with hypertension because of the possibility of these procedures, especially in the older sclerotic group, producing a sudden failure in venous return and thus causing a definite drop in blood pressure This objection would also apply to the use of caudal anesthesia as a preoperative test

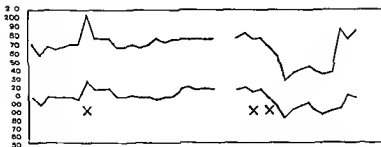
Grinson, Kernodle and Hill¹⁶ studied the problem experimentally as well as clinically and concluded that the response of dogs with experimental neurogenic hypertension and of clinical patients with essential or malignant hypertension was so variable as to often cause the results of these tests to be misleading

Evidence of advanced vascular changes such as cerebral vascular accidents, impaired cardiac function, or severe retinal changes are unfavorable signs and should be considered as a contraindication to operation However, an occasional patient who on medical management has shown marked clinical improvement in his visceral involve

twenty

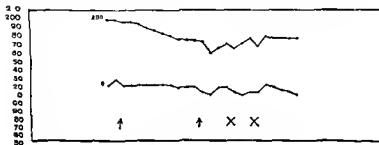
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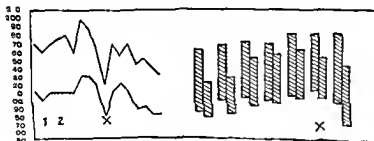


A

Sodium amytal orally - BP at 1 hr intervals
X = 6 gr sodium amytal



B



Highest & lowest BP on successive days after operation
X = Patient first out of bed

C



Highest & lowest BP on successive days after operation
X = Patient first out of bed

D

Fig 47

ment may be considered as a candidate if his present responses to the criteria already mentioned are satisfactory.

CASE V—C. S., a 41 year old white man, had begun to have daily fronto-occipital headache two years before. At that time examination revealed the blood pressure to be elevated. Recently the headaches had been more severe and he had not been able to sleep at night without sedation. Dizziness, especially with postural change, had also developed. His systolic pressure had varied between 155 and 185 during the preceding year and a half.

The patient was a stocky, moderately obese male. General physical and neurological examinations were essentially negative. The fundi showed mild retinal arteriosclerosis bilaterally but there were no hemorrhages, exudates or edema. The blood pressure was 200/110 at the initial examination and its range was 180-230/130-108 (Fig 47, A). The specific gravity of the urine was 1.023 and there were no albumin or casts. The nonprotein nitrogen content of the blood was 37 mg per 100 cc. An x ray of the chest showed moderate enlargement of the heart but was otherwise negative. An electrocardiogram was reported as essentially normal. After the oral administration of two doses of 8 grains each of sodium amylal two hours apart the blood pressure fell to 130/94 (Fig 47, A). The administration of 15 grains of sodium pentothal intravenously produced a fall to 158/103 (Fig 47, B). The patient's headaches improved with bed rest and sympathectomy was advised.

A Smithwick type of thoracolumbar sympathectomy and splanchnicectomy was carried out in two stages: the first on July 6, 1914; the second on July 20, 1914. At the first stage the right thoracic tenth to lumbar second sympathetic ganglia and the splanchnic nerves were removed. The splanchnic nerves were resected from

the operations

This patient in the older age group with a relatively poor response

SUMMARY AND CONCLUSION

Sympathectomy has gradually become established as a procedure of great value in various peripheral vascular diseases and in essential hypertension. In peripheral vascular disease its chief value is the in-

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LARGE NONPULSATING HEMATOMA (FALSE ANEURYSM)

WILLIAM J. PICKETT, M.D., F.A.C.S.* AND MORRIS T. FRIEDEL, M.D.†

An aneurysm usually develops soon after trauma of the blood vessels. Harbison, reporting his experience in World War II, mentions an interval of four days to three months between the injury and the development of an aneurysm. In World War II, recognition of both true and false aneurysms was enhanced chiefly because of the enlightened surgeon's suspicion of their possibility. The treatment is entirely surgical. Some patients were treated promptly in forward areas and many were treated in the Zone of the Interior shortly after removal from advanced areas.

The diagnosis of an arteriovenous fistula is facilitated if the physician maintains an alert attitude. The diagnosis of a false aneurysm may be difficult because of the absence of those characteristics which are considered typical. These include a history of a penetrating wound, development of a slowly enlarging mass, presence of pulsatile features, and auditory bruits or palpable thrills. We are presenting a case of false aneurysm in which the delay between wound and occurrence of visible swelling was seven years. In this case the sac reached a huge size and the only other characteristic of false aneurysm was the progressive enlargement of the swelling.

A Negro, aged 39, was admitted to the Cook County Hospital.

... a well-nourished Negro. A small scar representing the old bullet wound was located just below the midpoint of the left clavicle. A large, moderately tender mass, about the size of a basketball, was present on the left anterior chest wall.

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mass but a foreign body was not found (Fig. 48)



Fig. 48—X ray study of the left axillary region depicting site and extent of the false aneurysm

Aspiration of the softest areas revealed amorphous debris which grossly ap-

peared
in size

OPERATIVE PROCEDURE

Operation was performed on February 28, 1946 with the patient under general anesthesia. The axillary vessels were exposed through a transverse incision dividing the pectoralis muscles near the site of insertion. Many large collateral vessels were found and these were

The axillary vessels and, to
ve trunks were found to be
of the size was demonstrated

to arise from the vicinity of the second portion of the axillary vessels. Both the axillary artery and vein appeared to have been completely occluded by the dense fibrosis. Several large vessels seemed to supply the medial wall of the sac apparently deriving from the pectoral or costal branches. These were divided and ligated. With the neck of the sac under direct visualization and the major axillary vessels under direct control it was felt that it was safe to open the aneurysm. The incision was extended downward along the anterior axillary line which exposed the sac as a well defined thick walled cavity extending beneath the pectoralis major filling the entire axillary space and encroaching well into the subscapular area. Resection of the aneurysmal sac was obviously hopeless. The wall was then incised and 4 to 5 liters organized and fresh thrombus was scooped out. There was little fresh hemorrhage, a few small venous channels in the posterior wall of the cavity continued to ooze and were sutured from within. No brisk arterial bleeding occurred in spite of the fact that pressure on the neck of the sac at the axillary region was released. The cavity was then packed with petrolatum gauze and the wound closed loosely, the pack and three soft rubber drains being brought out through the lower pole of the incision. The pectoral muscles were restored to continuity. The patient received 500 cc of whole blood during the operation.

Recovery was uneventful. The pack and drains were partially removed after forty eight hours and completely removed on the fourth postoperative day. A week after the operation transitory edema of the left arm occurred but it subsided in two or three days. There was no demonstrable change in function or circulation of the left upper extremity from the preoperative status. The wounds healed promptly except for a persisting fistula at the drainage site for almost a month.

COMMENT

In this case exposure and control of the axillary vessels before a direct approach to the aneurysm was made and the ligation of the chief tributaries to the sac enabled us to open the cavity without fear of extensive hemorrhage. Unusual features were:

1. Suspicion of an aneurysm when dealing with obscure swellings in the region of major vessels will often prevent a disastrous conclusion.

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POSTERIOR APPROACH TO THE KNEE

H. KELIKIAN, MD. F.A.C.S.*

THE two rear compartments of the knee, their contents and communications are best explored through superimposed posterolateral

49 to 53)

which call for such exploration are the knee capsule, metallic foreign



Fig. 49—Lateral slightly oblique pneumogram of the knee showing the overlapping shadows cast by the air-filled medial and lateral compartments of the posterior knee.

bodies, lateral semilunar cartilage which has been pulled off in connection with avulsed posterior cruciate, menisci which have been inadequately extirpated, fragments of bone and osteocartilaginous loose bodies, and flexion contractures of the knee which require posterior capsulotomy and pyogenic arthritis with necessity for dependent drainage (Figs. 54 to 66).

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* Associate in Bone and Joint Surgery, Northwestern University Medical School.



Fig 50



Fig 51

Fig 50—Lateral view pneumogram showing a large bilocular outpouching of the medial compartment of the posterior knee. The loculation nearer the joint underlies the medial head of the gastrocnemius the one farther back accompanies the tendon of the semimembranosus hence the name gastrocnemio-semimembranosus "bursa" or outpouching.

Fig 51—Pneumogram showing a tortuous variety of the same.



Fig 52



Fig 53

Fig 52—Pneumogram showing the air-filled synovial diverticulum which accompanies the tendinous origin of the popliteus muscle. This pouch connects with the posterolateral compartment of the knee.

Fig 53—Less commonly a synovial tube connects the posterolateral compartment with the proximal tibiofibular joint as shown in this pneumogram.

Fig 54



Fig 55

Fig 54 m - - - - -

Fig 55



Fig 56



Fig 57

Fig 56—Anteroposterior pneumogram of the knee. Note the large metallic piece in the region of the intercondylar notch, either behind or in front of the substance of the anterior cruciate ligament.

Fig 57—Lateral view of the same with the piece of metal seen in the air-filled outer compartment of the posterior knee.



Fig 58



Fig 59

Fig 58—Lateral view pneumogram of the knee showing a large piece of bone avulsed from the tibia by the posterior cruciate.

Fig 59—Anteroposterior view of the same. Note the lateral meniscus which has been loosened and drawn towards the middle of the knee by the posterior cruciate ligament to which it is firmly attached.

Landmarks.—The diamond shaped popliteal space is bound above by the biceps femoris laterally and by the semimembranosus on its



Fig. 60



Fig. 61.

Fig. 60.—Photograph of the surgically removed lateral meniscus which had been lifted and drawn towards the middle of the joint by the avulsed posterior cruciate ligament.

Fig. 61.—Photograph of the remnant of a bucket handle medial meniscus which had been incompletely extirpated leaving a large chewed up piece in the posterolateral compartment of the knee.



Fig. 62



Fig. 63

Fig. 62.—Lateral view pneumogram of the anterior knee. The

Fig. 63.—Lateral view pneumogram of the knee joint.

Fig. 63.—Lateral view pneumogram of the knee joint.

medial side, inferiorly the two heads of the gastrocnemius form an indistinct V which is compassed by the diverging long limbs of the



Fig 56



Fig 57

Fig 56—Anteroposterior pneumogram of the knee. Note the large metallic

object in the posterior knee



Fig 58



Fig 59

hamstring muscles. The semimembranosus sweeps down and inward, and overlaps the inner head of the gastrocnemius, it inserts into a transverse groove on the medial tuberosity of the tibia just beneath its articular margin. The biceps femoris descends in the form of a stout tendon partly covers the lateral head of the gastrocnemius and reaches the head of the fibula. In flexion the hamstrings bow backward away from the respective heads of the gastrocnemius, in extension they move forward towards the sides of the femoral condyles. The posterior compartments of the knee joint are opened with the knee



Fig 67



Fig 68

relation to the flexion crease of the popliteal space. The incisions curve around the crease and do not cross it.

in extension though after opening the capsule the interior of the joint is best explored with the knee in slight flexion. The inner head of the gastrocnemius arises at a higher level from the femoral condyle than the outer and the groove it forms with the semimembranosus constitutes a safe and comparatively avascular approach to the medial compartment of the posterior knee. The lateral chamber of the posterior knee is approached in the interspace between the tendon of the biceps femoris and the outer head of the gastrocnemius. The peroneal nerve descends down towards the neck of the fibula under the shelving posterior border of the biceps tendon.

Fig. 64



Fig. 65

Fig. 66

Fig. 64—In rheumatoid arthritis contracture of the posterior capsule often draws the tibia up and backward as shown. Posterior capsulotomy is at times resorted to in these cases so as to bring the tibia under the femur.

Fig. 65—Anteroposterior film showing extensive destruction of contact and pressure areas of opposing articular surfaces of the femur and tibia in a case of pyogenic arthritis.

leading
to drain
infection in

Fig 71

Fig 72



Fig 73

presented several large villi

Fig 73—Pneumogram showing multiple diverticulæ of the removed by posteromedial bones were extracted from

e bodies in

These were

lage covered

by a small counterincision

From side to side the popliteal space is crossed by a flexion crease which sometimes bifurcates on the medial side. The flexion crease slants down and medially from a point a thumb's breadth above the inferior articular border of the lateral femoral condyle, across the bulging heads of the gastrocnemius, it ends just proximal to the inferior articular border of the medial condyle of the femur. The flexion crease thus lies on a higher level than the tibial plateau; the synovial cavity descends slightly lower than the tibial border. The main expansion of the synovial cavity overlies the femoral condyles below the origins of the two heads of the gastrocnemius. It is over the medial and the lateral condyles that the respective compartments of the knee are opened and the flexion crease of the popliteal space is a landmark that should be bypassed and never crossed (Figs 67 and 68).

POSTEROMEDIAL APPROACH

The condition which most commonly necessitates posteromedial approach to the knee is the popliteal outpouching of the inner compartment. The outpouching of the knee capsule dissects its way between the medial head of the gastrocnemius and the semimembranosus.

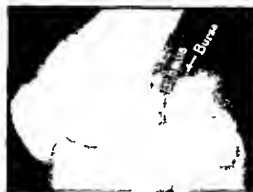


Fig 69



Fig 70

Fig 69—Gastrocnemio-semimembranosus bursa visualized by introduction of iodized oil into the bursa itself. Note the narrow isthmus leading towards the far al

localized irritations. The sac may become filled with thick glairy exu

lilaginous loose bodies. Such bodies formed in the main knee cavity may gravitate into the popliteal outpouching. The isthmus which connects the sac to the medial compartment of the knee is sometimes too narrow to permit the passage of anything but air or thin transudate.

Fig 78.

Fig 79



Fig 80

Fig 78—Skin incision and exposure of the deep fascia

Fig 79—Draping of the wound incision of the deep fascia and dissection of the mass away from semimembranosus

Fig 80—Deeper dissection of the mass away from the medial head of the gastrocnemius

More often it will allow the passage of a sizeable probe (Figs 69 to 73)

The extirpation of the gastrocnemio semimembranosus pouch and exploration of the posteromedial compartment of the knee offers no



Fig 74

Fig 75

Fig 74—Photograph indicating the bulging of the lower popliteal space (right) as compared to the normal (on the left)

Fig 75—Antero-oblique view of the same. The popliteal bulge is shown extending down and medially



Fig 76

Fig 77

Fig 76—Lateral view pneumogram of the same

Fig 77—Oblique view of the same

dates which will not empty into the main knee. The tumor may cause marked bulging backwards with tension and interferes with flexion. The lining of the popliteal pouch may form villi or grapelike osteocar-

difficulty The incision begins at a point 3 inches above the flexion crease of the knee, over the bulging belly of the semimembranosus, it passes down and medially to avoid crossing the flexion crease of the popliteal space and then curves back to end about 2 inches below the crease The popliteal fascia is slit lengthwise and the semitendinosus tendon is identified The groove between the medial head of the gastrocnemius and the semimembranosus is sought The gastrocnemio semimembranosus "bursa" if distended or if localized pathological changes are suspected is carefully dissected and traced upward and forward Near where the outpouching enters the joint its walls become firmly attached to the gastrocnemius and semimembranosus and will not strip easily, it is cut away by sharp dissection, and the isthmus leading into the joint is removed The sac is not likely to reform (Figs 74 to 85)

Where the gastrocnemio semimembranosus bursa is not bulging and the posteromedial compartment of the knee has to be explored, the same route is pursued The medial head of the gastrocnemius is retracted outward and the semimembranosus inward, the knee capsule is incised lengthwise over the medial condyle of the femur, between the origin of the medial head of the gastrocnemius and the upper articular rim of the tibia Slight flexion of the knee makes the exploration of the posterior compartment easier

POSTEROLATERAL APPROACH

Osteocartilaginous loose bodies may lodge in either compartment

above the joint level and retains its relative location in all positions of the knee osteocartilaginous loose bodies gravitate to the most dependent portions of the knee unless caught in a diverticulum Osteocartilaginous bodies possess coarser texture and in pneumograms they are surrounded by the shadow cast by air (Fig. 86)

Osteocartilaginous loose bodies may arise from the synovial lining of the joint, from detached osteophytes or intra articular fractures, but when seen in the lateral compartment of the posterior knee one must suspect osteochondritis dissecans of the lateral condyle In the more frequent osteochondritis dissecans of the anterior knee, the cartilage coated fragment separates itself from the medial femoral condyle below and in front of the origin of the posterior cruciate Osteochondritis dissecans of the posterior knee most commonly affects the area of the lateral condyle just below and behind the attachment of the anterior cruciate ligament Perhaps it is not sheer coincidence that the split-off cartilages of osteochondritis dissecans commonly detach



Fig 81



Fig 82



Fig 83

Fig 81—Complete dissection of the mass down to a neck connecting it with the knee

Fig 82—The neck is clamped and the mass removed, a probe is passed into the aperture leading to the medial compartment of the posterior knee

Fig 83—The synovial membrane leading into the joint is sharply dissected and gastrocnemius and semimembranosus are allowed to fall together. Forceps points to semitendinosus

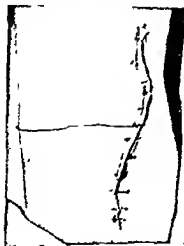


Fig 84



Fig 85

Fig 84—Photograph showing closure of the incision

Fig 85—Photograph of the dissected specimen

difficulty The incision begins at a point 3 inches above the flexion crease of the knee, over the bulging belly of the semimembranosus, it passes down and medially to avoid crossing the flexion crease of the popliteal space and then curves back to end about 2 inches below the crease The popliteal fascia is split lengthwise and the semitendinosus tendon is identified The groove between the medial head of the gastrocnemius and the semimembranosus is sought The gastrocnemio semimembranosus 'bursa,' if distended or if localized pathological changes are suspected, is carefully dissected and traced upward and forward Near where the outpouching enters the joint its walls become firmly attached to the gastrocnemius and semimembranosus and will not strip easily, it is cut away by sharp dissection, and the isthmus leading into the joint is removed The sac is not likely to reform (Figs 74 to 85)

Where the gastrocnemio semimembranosus 'bursa' is not bulging and the posteromedial compartment of the knee has to be explored, the same route is pursued The medial head of the gastrocnemius is retracted outward and the semimembranosus inward, the knee capsule is incised lengthwise over the medial condyle of the femur, between the origin of the medial head of the gastrocnemius and the upper articular rim of the tibia Slight flexion of the knee makes the exploration of the posterior compartment easier

POSTEROLATERAL APPROACH

Osteocartilaginous loose bodies may lodge in either compartment of the posterior knee When a loose body is seen in the lateral compartment, the lateral compartment should be explored

seen in the lateral head of the gastrocnemius The sesamoid bone lies above the joint level and retains its relative location in all positions of the knee, osteocartilaginous loose bodies gravitate to the most dependent portions of the knee unless caught in a diverticulum Osteocartilaginous bodies possess coarser texture and in pneumograms they are surrounded by the shadow cast by air (Fig 86)

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Fig 86--Single osteocartilaginous body caught in a diverticulum it is shaped like but is not to be confused with fabella often seen in the lateral head of the gastrocnemius. Osteocartilaginous loose body possesses coarser texture than the sesamoid bone and in pneumogram as shown above it is surrounded with the shadow cast by air.



Fig 87



Fig 88

Fig 87--Oblique view pneumogram showing a large osteochondritic body of the lateral condyle of the left femur. There is also a small ossicle in the front of the knee.

Fig 88--The same with the patient in prone position so as to allow the air to ascend towards the back of the knee. Note that the shadow cast by the air almost encircles the osteochondritic body indicating its partial separation. A small air-filled isthmus connects the knee joint with the proximal tibiofibular articulation.

themselves from the portions of the femoral condyles near where the cruciate ligaments originate. Disturbances of the blood supply con-



Fig. 89—Photograph of the specimens which were removed surgically, the larger one through a posterolateral approach the smaller piece was extracted by a counter slit into the anterior knee with the leg flexed on the thigh



Fig. 90



Fig. 91

Fig. 90—Oblique view film showing multiple osteocartilaginous loose bodies in the lateral compartment of the posterior knee

Fig. 91—Lateral view film showing a slender osteocartilaginous loose body which has slipped into the diverticulum along popliteus tendon

veyed by the synovial investment of these ligaments may have something to do with the vascular necrosis of the detached bone (Figs 87 to 89)



like
gast
sesa
shadow cast by air



Fig 87



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Fig 87—Oblique view pneumogram showing a large osteochondral body of the lateral condyle of the left femur. There is also a small ossicle in the front of the knee.

Fig 88—The same with the patient in prone position so as to allow the air to ascend towards the back of the knee. Note that the shadow cast by the air almost encircles the osteochondral body indicating its partial separation. A small air-filled isthmus connects the knee joint with the proximal tibiofibular articulation.

The popliteus tendon arises from the outer aspect of the lateral femoral condyle and as it passes under the fibular collateral ligament it tugs away a fold of synovial membrane, which often communicates with the proximal tibiofibular joint. Osteocartilaginous bodies formed in the lateral compartment of the posterior knee may slip into this

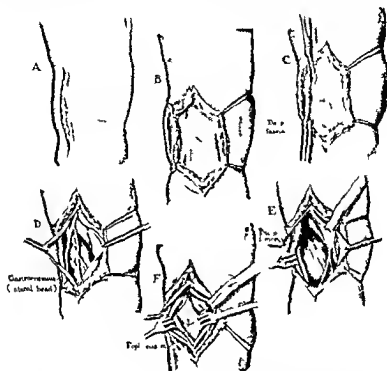


Fig 93—Drawings of the various steps of arthrotomy of posterolateral compartment of the knee. A The skin is incised. B The skin flaps are reflected. C The deep fascia is carefully split. D The gastrocnemius is pulled outward exposing the condyle of the femur. E The condyle of the femur is exposed. F The condyle of the femur is exposed and the gastrocnemius is pulled outward.

direction of its branches is noted. F The condyle of the femur is exposed and the gastrocnemius is pulled outward exposing the condyle of the femur.

diverticulum become incarcerated and create special problems of localization and extraction. They may be single or multiple (Figs 90 to 94).

Exploration of the posterolateral compartment of the knee is fraught with one danger, that of damaging the peroneal nerve. The incision



Fig 92



Fig 93

Fig 92—Osteocartilaginous loose body incarcerated in the synovial tube leading into the proximal tibiofibular joint. On arthrotomy of the posterior compartment the loose body was not seen, it was palpated but could not be expressed until the narrow isthmus leading into the tibiofibular joint was slit open. Note in this pneumogram the extra articular fabella. Compare the fine texture of the sesamoid bone with the coarse trabeculation of the loose body.

Fig 93—Photograph of the extracted osteocartilaginous loose body.



Fig 94—Multiple osteocartilaginous loose bodies in the popliteus diverticulum. The opposite knee of this patient was similarly affected.

The popliteus tendon arises from the outer aspect of the lateral femoral condyle and as it passes under the fibular collateral ligament it tugs away a fold of synovial membrane which often communicates with the proximal tibiofibular joint. Osteocartilaginous bodies formed in the lateral compartment of the posterior knee may slip into this

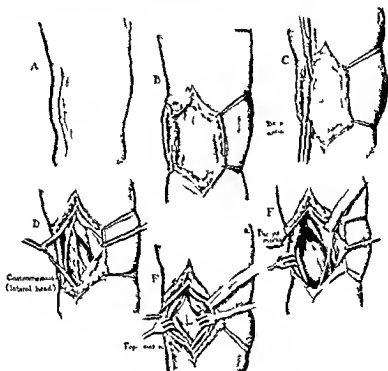


Fig 95—Drawings of the various steps of arthrotomy of posterolateral compartment. A. Skin incision. B. Dissection of the skin and subcutaneous tissue. C. Dissection of the popliteus tendon and its associated synovial fold. D. Dissection of the lateral head of the gastrocnemius muscle. E. Dissection of the popliteus tendon and its associated synovial fold. F. Dissection of the popliteus tendon and its associated synovial fold.

diverticulum become incarcerated and create special problems of localization and extraction. They may be single or multiple (Figs 90 to 94).

Exploration of the posterolateral compartment of the knee is fraught with one danger—that of damaging the peroneal nerve. The incision

begins about 3 inches proximal to the flexion crease and runs down over the tendon of the biceps femoris. It curves laterally, detours the flexion crease and then turns back, ending at a point about 2 inches below the crease. The biceps tendon is definitely distinguished from the broad iliotibial tract and its shelving posterior border is identified. A small stab is made into the popliteal fascia along the posterior border of the biceps and a curved blunt forceps is inserted under the fascia. The



Fig. 96—Frontal photograph of the knee showing the almost complete disappearance of the intercondylar septum of the anterior knee. Posteriorly the intercondylar notch of the femur is filled by the cruciate ligaments and their synovial investment which passes back towards the posterior capsule and constitutes a veritable septum between the two rear compartments of the knee.

popliteal fascia is incised lengthwise between the gently and intermittently spreading blades of the forceps so as to avoid injuring the peroneal nerve. A soft rubber tube is placed around the nerve and it is

side the capsule is opened lengthwise. If more room is needed the point of origin of the popliteus is stripped away (Fig. 95)

begins about 3 inches proximal to the flexion crease and runs down over the tendon of the biceps femoris. It curves laterally, detours the flexion crease and then turns back, ending at a point about 2 inches below the crease. The biceps tendon is definitely distinguished from the broad iliotibial tract and its shelving posterior border is identified. A small stab is made into the popliteal fascia along the posterior border of the biceps and a curved blunt forceps is inserted under the fascia. The



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popliteal fascia is incised lengthwise between the gently and intermittently spreading blades of the forceps so as to avoid injuring the peroneal nerve. A soft rubber tube is placed around the nerve and it is retracted in the direction of its branches, medially. The posterior compartment is now safely approached in the interspace between the outer head of the gastrocnemius and the biceps tendon. As on the medial side the capsule is opened lengthwise. If more room is needed the point of origin of the popliteus is stripped away (Fig 95).

ARTHROTOMY OF BOTH CHAMBERS FOR DEPENDENT DRAINAGE

Early in life a septum separates the two rear compartments of the knee. The septum in time becomes fenestrated, but occasionally it remains imperforate or is punctured by a small pin size hole. Through the synovial fold of the septum runs the thick posterior cruciate ligament which lends body to it. Thus spiked by the extrasynovial cruciate ligament the septum forms a veritable spur between the two rear chambers of the knee. In order to reach from one to the other, all but

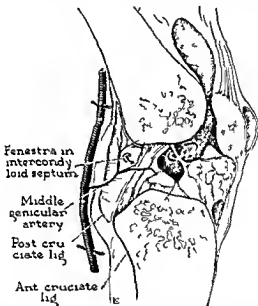


Fig 97—The septum separating the two rear compartments of the knee at times bears a fenestra at its proximal pole. Occasionally it remains imperforate. In either instance communication between one chamber and the other is more readily carried by way of the anterior knee where all that remains of intercondylar fat pad is the vestigial ligamentum mucosum which connects the infrapatellar fat pad to the synovial investment of the cruciates. Besides the latter the synovial envelope of the septum contains the middle genicular artery destined to nourish the parietes of the intercondylar notch of the femur.

very thin transudate must first pass to the front of the knee and then circle around to the other compartment. The posterior chambers of the knee thus possess better communication with the anterior knee than with one another (Fig 96).

In pyogenic arthritis both rear compartments of the posterior knee must be opened and drained, and not one alone. It is hazardous, often ineffectual, to open one chamber and then try to perforate the septum

so as to establish indirect drainage. Inflammatory conditions which primarily affect synovial surfaces thicken and mat the septum, the

97).

One need not broach upon the desirability of dependent drainage in pyogenic arthritis. There are, however, several hazards associated with

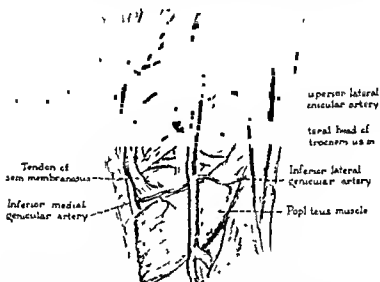


Fig 98—The popliteal artery descends down the back of the knee almost in midline. Besides the middle genicular it gives two sets of collateral arteries. The superior and inferior genicular arteries are padded away by muscles and do not cross the capsule covering the medial or the lateral compartments of the knee.

opening the posterior chambers of the knee in the presence of infection and these can only be obviated by judicious planning.

Hemorrhage, primary or secondary, constitutes a grave danger. The popliteal artery passes down the midline between the two heads of the gastrocnemius in close relation to the posterior capsule of the knee. Its superior genicular branches embrace the femur above the origin of the gastrocnemial heads, the inferior genicular arteries hug the tibia distal to the joint level. The inferior medial genicular artery lies below the insertion of the popliteus muscle and is slung over the main popliteal artery. The inferior lateral genicular artery is neither

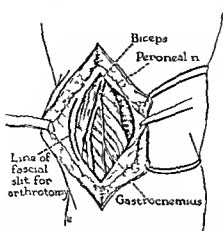
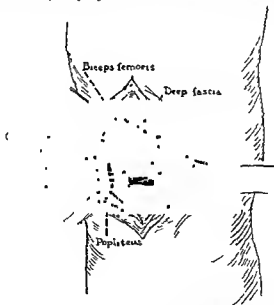


Fig 99—Drawing showing the relations of peroneal nerve. It passes behind and medial to the biceps tendon, over the lateral head of gastrocnemius. Note the line of incision into the deep fascia in front of and lateral to the biceps tendon. This incision is used only in pyogenic arthritis. The nerve is not exposed.



The incision is placed in front of the articular tissue involvement of the peroneal nerve at its insertion into the head of the femur, the detached ends of the joint capsule is fenestrated and a wedge of the lateral semilunar cartilage is removed.

cartilage-covered surfaces of the posterior condyles of the femur and the capsule shielding these surfaces can be fenestrated with impunity. The medial compartment of the posterior knee is penetrated in the interspace between the inner head of the gastrocnemius and the semimembranosus, the lateral chamber is opened in that portion of the posterior capsule which lies between the outer head of the gastrocnemius and the tendinous origin of the popliteus. Hemorrhage is fur-

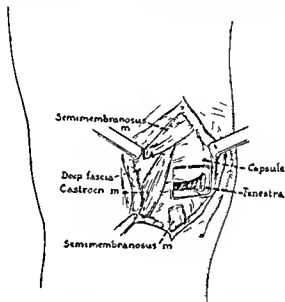


Fig 101—Drawing of posteromedial arthrotomy. A smaller incision than is usually made for uninfected cases is developed in the intermuscular space between semimembranosus and the medial head of the gastrocnemius. The semimembranosus tendon is tenotomized and its proximal severed end is sutured to the deep fascia, the joint capsule is fenestrated, not merely incised; a wedge of the medial meniscus or its entire posterior horn is removed; no drain is inserted, the limb is placed in traction, preferably in skeletal traction to keep the opposed articular surfaces of the femur and the tibia apart.

ther obviated by developing the deeper incision in the interspace
re inser-

, consti-
tutes another hazard (Fig 99). The nerve may be injured primarily during the dissection or it may become involved in subsequent scarring. Both primary injury and secondary neuritis can be obviated by placing the incision for drainage of the lateral compartment in front

of the tendon of the biceps femoris rather than behind it, as is ordinarily used for uninfected cases. The biceps tendon is traced to its insertion to the fibular head and severed. It is cut and is reflected backward and medially sutured to the popliteal fascia so as to serve as a protective pad to the peroneal nerve.

Spontaneous closure of the sinus and damming back of pus constitutes the third drawback to popliteal drainage of the knee. The deep fascia of the popliteal space serves as a retinaculum, or sling, to the

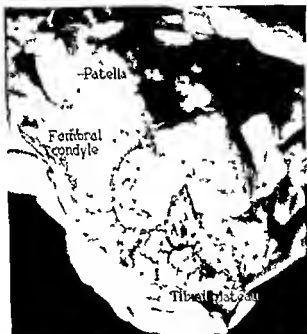


Fig 102—Photograph of another pyogenic knee which had been treated by parapatellar incisions and chemotherapy (penicillin and sulfa drugs). The extensive destruction of contact and pressure areas of both the femur and the tibia occurred within a month of compound injury. The limb had to be amputated because of sepsis. It might have been saved by adequate dependent drainage.

hamstring tendons, and its fibers are disposed in circular fashion. When severed transversely the cut edges of the popliteal fascia soon span the gap, of the popliteal space. The popliteal space may be incised longitudinally.

of the posterior knee and the biceps and popliteus on the lateral side exercise a shutter effect. All these muscles must be tenotomized, reflected from over the capsule and sutured to the deep fascia. The

biceps tendon is severed from its insertion into the fibular head turned backward over the peroneal nerve and sutured to the deep fascia the popliteus is severed from its origin and turned downward The semimembranosus tendon is tenotomized at about the joint level and its cut proximal end is dissected upwards and is sutured to the deep fascia The exposed posterior capsule over the femoral condyles is fenestrated not merely incised and the posterior horns of both medial

ing the posterior compartments of the knee As noted the incisions must not cross the flexion crease of the popliteal space and deeper dissections must be carried between the muscles and not through them

After posterior arthrotomy the knee must be immobilized in extension

bearing surfaces of the femoral condyles and of the tibial plateau bear the brunt of the greatest destruction (Fig 102) These surfaces must be kept apart

SUMMARY AND CONCLUSIONS

The two rear compartments of the knee are best approached by direct posterolateral and posteromedial incisions There are numerous conditions which necessitate posterior arthrotomy Gastrocnemio semimembranosus outpouching of the medial chamber and osteo-cartilaginous loose bodies in the lateral compartment or within the communications are the commonest conditions which call for posterior approach to the knee

A plea is made in behalf of bicompartimental arthrotomy for adequate dependent drainage of the knee in pyogenic arthritis The hazards and the handicaps of such a procedure are discussed and it is pointed out that they can all be avoided by judicious planning

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biceps tendon is severed from its insertion into the fibular head, turned backward over the peroneal nerve and sutured to the deep fascia, the popliteus is severed from its origin and turned downward. The semimembranosus tendon is tenotomized at about the joint level and its cut proximal end is dissected upwards and is sutured to the deep fascia. The exposed posterior capsule over the femoral condyles is fenestrated, not merely incised, and the posterior horns of both medial and lateral semilunar cartilages are extirpated to promote free and adequate drainage (Figs 100 and 101).

Flexion contracture of the knee and scar tissue matting of the popliteal space constitute the fourth and final undesirable sequel to draining the posterior compartments of the knee. As noted, the incisions must not cross the flexion crease of the popliteal space and deeper dissections must be carried between the muscles and not through them.

After posterior arthrotomy the knee must be immobilized in extension or subjected to skeletal traction through the distal tibia. In pyogenic arthritis contact and pressure areas of opposed articular surfaces are destroyed first and most extensively (Phemister). In the knee the bearing surfaces of the femoral condyles and of the tibial plateau bear the brunt of the greatest destruction (Fig 102). These surfaces must be kept apart.

SUMMARY AND CONCLUSIONS

The two rear compartments of the knee are best approached by direct posterolateral and posteromedial incisions. There are numerous conditions which necessitate posterior arthrotomy: Gastrocnemio semimembranosus outpouching of the medial chamber and osteo cartilaginous loose bodies in the lateral compartment or within the communications are the commonest conditions which call for posterior approach to the knee.

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OSTEOMYELITIS

PHILIP LEWIN, M D, F A C S,* AND LOUIS SCHEMAN, M D †

Definition—Osteomyelitis is an infection of bone derived exogenously by direct implantation of bacteria or endogenously by bacterial metastasis incident in the bacteremic or septicemic phase of an acute systemic infection

ANATOMICAL CONSIDERATIONS AND PATHOGENESIS

Certain factors relating to the structure and blood supply of bones are important in understanding the pathogenesis and development of the osteomyelitic process. While the basic picture of acute inflammation is each of

which is composed of calcified connective tissue laid down in layers or lamellae about central haversian canals. There is free communication

with each other and with the central haversian canals by way of minute canaliculi

The haversian canals contain blood vessels, nerves and lymphatic vessels. The covering of compact bone above described, the periosteum has in its inner layer osteoblastic cells which are capable of a varying degree of osteogenetic activity depending on the age of the individual or the stimulus to bone production. Similar cells line the inside of the compact bone in the endosteum. The interior of long bones is made up of thin interlacing plates of bone enclosing the medullary spaces. These spaces contain the marrow elements (Fig 103)

This anatomical situation makes clear the manner in which a purulent focus in bone may spread from the interior to the subperiosteal area by way of the haversian canals. Thus a subperiosteal abscess may form or the pus may penetrate the periosteal barrier and point to reach the surface (Fig 104). The abscess may dissect the periosteum but will meet with considerable resistance at the epiphyseal plate where

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The site of predilection of osteomyelitis is in the metaphysis. Certain anatomic features help to explain the pathogenesis of the lesion. Lexer's classic description in 1903 of the circulation of long bones still

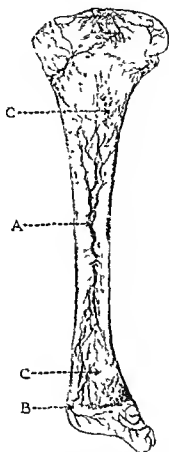


Fig. 103—Circulation of infant's tibia (after Lexer) A, Nutrient artery, B, Metaphyseal capsular artery, C, Relative avascular zone, where sequestrum separation usually occurs (Redrawn from F W Bancroft, *Ann Surgery*, June, 1921, 681)

In growing bone, these vessels become end arteries on reaching the

the periosteum dips in and has a very firm attachment preventing, in most cases, extension into the joint

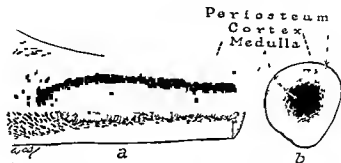


Fig 103—*a* Longitudinal and *b* transverse sections of a tibia

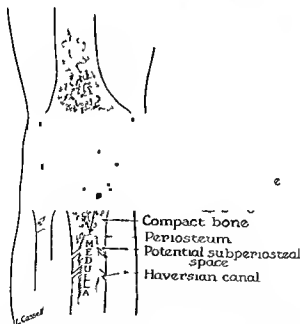


Fig 104—Schematic representation of long bone showing directions of possible spread of infection from the metaphysis (Cited by Platt and redrawn from Choyce's "A System of Surgery 1923 Vol 3 p 736")

Necrosis of bone as evidenced by death of bone cells results from mechanical occlusion of the vessels by pressure of the exudate the toxins from the inflammatory process and the thrombotic occlusion of the vessels as the inflammation spreads

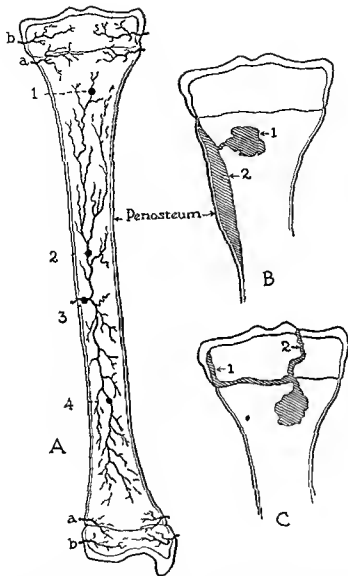


Fig 107—Schematic presentation of the pathogenesis of acute osteomyelitis
 A Nutrient vessels of the tibia—1, 2 3 and 4 the area involved in hypotheated

to the joint, the most common route, or (2) by direct extension through the epiphyseal cartilage to the joint. (Redrawn from Hertzler, A. E. Surgical Pathology of Diseases of Bone. J B Lippincott, 1930-1931)

epiphyseal plate and form loops which pass into dilated venous channels (Fig. 105)

As the vessels branch through the haversian canals they eventually reach the surface where they communicate with a second system of vessels in the inner periosteal layer. The latter vessels are derived from the surrounding structures. An additional blood supply is obtained from vessels which irregularly perforate the bony cortex and anastomose with the main channels (Fig. 106)

It has been shown experimentally that bacteria traveling by way of the blood stream tend to localize particularly in metaphysis the

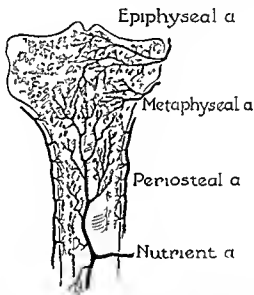


Fig. 106—Diagrammatic representation of the blood supply to various portions of a long bone such as the tibia. Note penetration of epiphyseal plate by fine vessels

epiphysis and the subperiosteal vascular area of bone. Because of the paucity of phagocytic elements in the metaphysis and the anatomic arrangement of the blood vessels in this area, conducive to slowing of the stream, organisms will multiply readily.

Wilensky has emphasized the importance of vascular thrombosis in

thrombosed vessel
to the importance of vascular occlusion in the pathogenesis of osteomyelitis. Our own work in the production of experimental osteomyelitis

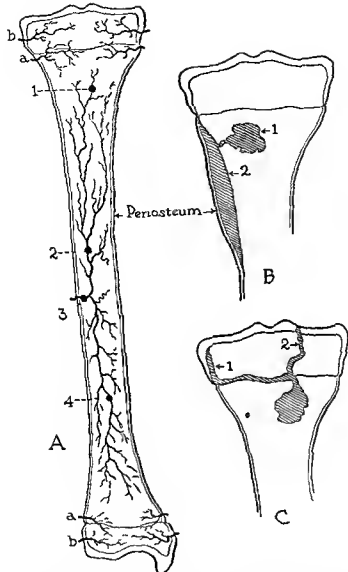


Fig 107—Schematic presentation of the pathogenesis of acute osteomyelitis. A, Nutrient vessels of the tibia—1, 2, 3 and 4, the area involved in hypothecated emboli, 1 would involve only the metaphyseal area, the common occurrence, 2 would involve the entire proximal portion, 3 would involve the entire shaft, while 4 would involve the distal portion, and 1 and 4 would involve the two extremities but not the central portion of the shaft, a not uncommon occurrence. B, Route which a central abscess takes to reach the subperiosteal region, 1, the abscess, 2, the extension beneath the periosteum. C, Route of travel which a joint infection takes, either (1) following the epiphyseal line to reach the subcapsular area, hence to the joint, the most common route, or (2) by direct extension through the epiphyseal cartilage to the joint. (Redrawn from Hertzler, A. E. Surgical Pathology of Diseases of Bone, J B Lippincott, 1930-1931)

indicates that vascular thrombosis provides the soil for the propagation of osteomyelitis (Fig 107).

One other anatomic fact deserves mentioning, with relation to the metaphyseal localization of osteomyelitis in children. As Robertson has pointed out, the epiphyses bear the brunt of injuring stresses even to the point of separation rather than the periarticular structures, as is the case in more mature bone. Where such separation occurs the cleavage is on the metaphyseal side and trauma insufficient to produce separation causes hemorrhage with injury to cells—a potential *locus minoris resistentiae*.

ETIOLOGY

Acute hematogenous osteomyelitis is a blood stream infection usually primary in a distant focus such as the tonsil, mouth, skin and wounds of the skin. An osteomyelitic process may also develop in bone as a result of bacterial contamination of wounds penetrating to bone, compound fractures, and surgical procedures involving bone.

In the hematogenous form, bacteria may be recovered from the blood stream during the bacteremic phase which is quite transient, or in the presence of septicemia. In the more fulminating type of the disease, the blood culture may be persistently positive. It is well to remember that visceral localization of the infection may occur.

spread of most reported series is between ages 5 and 14 with fewer cases below ages 5 and past 14. Most series have twice as many males as females. The bones most often affected are the tibia, femur, humerus, radius, fibula, pelvis, tarsus, vertebrae, carpus, skull and scapula in that order, with a preponderance of involvement in the tibia, femur and humerus.

A history of preceding trauma in the nature of a blow, twist or strain

be obtained. Sometimes a recent trauma may precede the osteomyelitis.

PATHOLOGY

The disease starts in the juxtaepiphyseal region or metaphysis of a long bone. In the presence of bacteremia or septicemia, bacteria lodge in the finer capillaries of this region. This may be a thromboembolic phenomenon. In the presence of a generally lowered resistance or a *locus minoris resistentiae* due to trauma or other factors and aided by

the local factors described above an inflammatory process is set up. Within twenty four hours a grayish necrotic spot surrounded by a hyperemic zone is seen and evidence of some destruction of trabeculae is noted. With the breaking down of this necrotic tissue, pus forms in minute quantities and spreads along the lines of least resistance. Opinion differs somewhat as to the exact line of spread. For a long time it was taught that the spread was toward the cancellous bone of the medullary cavity then outward by way of the haversian canals to the subperiosteal area. Starr, however, believes that the spread occurs early along the line of the epiphysis to the subperiosteal area along which it spreads and ultimately reaches the medullary spaces from without by way of the haversian canals. Starr's contention appears to be borne out by his pathologic data and animal experiments. The early acute stage of inflammation with pressure from the exudate is accompanied by pain swelling redness tenderness and toxemia.

The firm attachment of the periosteum at the epiphyseal line safeguards the neighboring joint from spread of infection along this route.

definite hyperemia of the synovial membrane of the joint and a serious effusion may take place.

According to Wilensky the pattern of the osteomyelitic process is determined by thrombosis of the bone vessels. The original involvement may be massive in the case of occlusion of a major vessel or the nutrient vessel itself or the process may extend by propagation of the original thrombus. Bone necrosis proceeds on this basis or as noted above by exudative occlusion of vessels confined within rigid walls. As necrosis and suppuration proceed sequestra or dead fragments of bone varying from molecular size to the entire shaft form in the inflam-

being destroyed new bone is being laid down by the osteoblasts of the inner periosteal layer. This new bone may assume considerable proportions and constitutes the involucrum.

The end results may be complete restitution of bone if absorption and replacement of necrotic bone have occurred. In the presence of large sequestra which cannot be absorbed the disease may enter a chronic phase with purulent exudate penetrating through cloacae in the involucrum and the formation of sinuses draining to the surface of the involved part. Cavities or defects in the bone may persist for years even after apparent healing has occurred and all drainage ceased. These cavities are filled with scar tissue of varying density. Defects in

the bone may also persist depending on their extent and the age of the patient. Articular surfaces once destroyed and absorbed are not replaced. The importance of the periosteum is evidenced by the completeness with which the shaft of a long bone may be restored in very young children after subperiosteal resection. Injury to or removal of periosteum by surgical procedures destroys this impetus to repair.

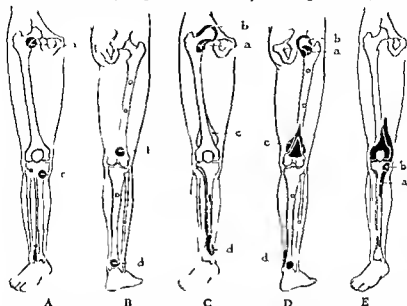


Fig 108—A Maximal points of tenderness in early cases of osteomyelitis Anterior aspect of lower extremity
 B, Maximal points of tenderness in early cases of osteomyelitis Posterior aspect of lower extremity
 C, Sites of subperiosteal abscesses from osteomyelitis Anterior aspect of lower extremity
 D, Sites of subperiosteal abscesses from osteomyelitis Posterior aspect of lower extremity
 E Sites of subperiosteal abscesses from focus at the upper end of the tibia
 (Kennon R Infectious Osteomyelitis Surg Gynec & Obst Vol 47)

Osteomyelitis of infants is of shorter duration has less frequent sequestration and more recurrences. The differences between the osteomyelitic process of infants and that of older children are largely dependent on three factors (1) the streptococcus is observed more frequently in infants than in older children (2) the anatomic construction of the bone in infants characterized by large cancellous spaces in the bone, allows the infection to pass more readily from its site of origin in the metaphysis to the subperiosteal space the periosteum is more loosely attached in infants and allows the decompression to occur

—the periosteum then ruptures allowing the pus to escape into the soft tissue without sequestration except in rare instances (3) the absorption of dead bone occurs more rapidly in infants as does the formation of new bone

SYMPTOMATOLOGY

The symptoms of acute osteomyelitis are pain of a boring character which is usually worse at night and sensitiveness to pressure There may be a chill high fever with leukocytosis and local evidence of pus

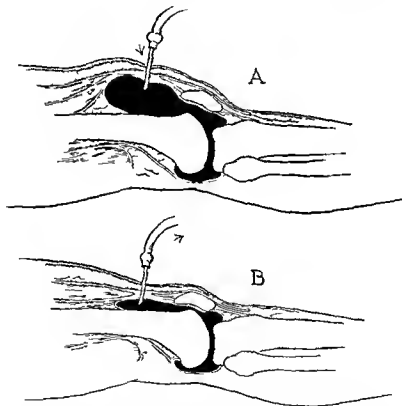


Fig 109—Suppurative arthritis of the knee (a complication of osteomyelitis) (Destruction of bone not shown.)

such as swelling redness and edema Pain is the constant early and predominant symptom This is located in the neighborhood of a joint at one end of a growing bone (Fig 10S) The pain is continuous throbbing and of great severity increased rather than decreased by the application of heat

DIAGNOSIS

It is important to remember that the roentgenogram will not reveal any pathologic change for as long as seven days after the onset of acute symptoms. The first sign will be a haziness in the metaphysis with thickening due to subperiosteal new bone formation. This may require a week or ten days to show definitely and will be followed by osteoporosis and destruction of bone structures.

Acute rheumatic fever is the commonest condition for which acute osteomyelitis is mistaken. Kennon emphasizes the fact that in acute rheumatism the onset of pain, tenderness and swelling are synchronous, whereas in osteomyelitis the swelling may not appear for two or three days.

Infective arthritis due to the gonococcus, pneumococcus or influenza bacillus may be acute and cause a severe toxemia but the signs and symptoms are articular.

Swelling, heat and pain are early and prominent symptoms. Aspiration of the joint (Fig. 109) and culture of the aspirate will confirm the findings. Cellulitis may cause pain and tenderness with toxic symptoms but the early swelling with redness should differentiate these lesions.

The blood culture in acute hematogenous osteomyelitis may be positive during the bacteremic phase. The latter is transient and more likely than not the blood culture will be negative. If it is persistently negative, the diagnosis is more fulminating type of osteomyelitis with the likelihood that

— — — — — to the bone focus

TREATMENT

... ..

on our ideas toward conservatism and away from the old tenets which demanded that an incision be made and bone chiseled away or drilled, as soon as the diagnosis was made. Certainly the experience of Robertson, Hoyt and others as well as our own with mounting numbers of cases, emphasizes the wisdom of approaching the problem primarily from a nonoperative standpoint and reserving surgical intervention for those cases in which, in spite of adequate measures pus fails to resorb and increasing tension and pain demand its release. Even under these circumstances the surgery should be minimal and for the purpose of drainage as possible. We believe that the management such

If at all possible, the patient should be hospitalized. A complete examination should include x rays of the involved part and a chest plate. Laboratory work should include a complete blood count and

urinalysis The hemoglobin and white count should be repeated daily during the early stages of the disease In the presence of a hemolytic organism the blood picture serves as a guide for the administration of

venous saline or saline and glucose as required In the presence of anorexia and 1 added In add give ascorbic mg three times a day, nicotinic acid 25 mg twice a day, oleum percomorphum 10 drops three times a day Where the oral route cannot be used, parenteral administration is available

The involved part should be immobilized in a plaster of Paris cast or other splint This will add much to the comfort of the patient and insure rest of the part The plaster should include at least the joint above and below the lesion to insure absolute immobility It may be

es, *sulfadiazine* is the most en will tolerate large doses The daily dose may be calculated on the basis of 4 to 6 grains per pound of body weight The initial dose for an adult is usually 2 gm followed by 1 gm every four hours day and night

Blood levels should be checked frequently and an effort made to maintain a level of about 10 mg per 100 cc Where the drug cannot be taken orally the sodium salt of sulfadiazine may be used in initial dose of 4 to 6 gm intravenously and a level maintained by the administration of 1 gm every 4 to 6 hours Adequate fluid intake must be maintained to avoid crystalluria and the urine must be checked frequently for hematuria or crystalluria

Penicillin has replaced the sulfa drugs to a large extent in the nonoperative treatment of osteomyelitis, however, they can be given concomitantly and in fulminating cases it is advisable to do so While the sulfa drugs are bacteriostatic in effect, penicillin is bactericidal in its action Penicillin is administered in a dilution of 1000 units per cubic centimeter The average daily dose is about 120 000 units administered in equal doses every three hours day and night It may be

much as the latter may lead to a certain amount of resistance on the part of the organisms

With management as described above it will be noted that many cases which show definite lesions on x ray and even sequestra will not

go on to suppuration and that healing and resorption may occur without abscess formation

In many instances abscesses which form will recede and absorb without drainage. It has been our practice where an abscess presents externally to aspirate and irrigate until the return is clear. Several grams of microcrystalline sulfadiazine or 5000 or more units of penicillin are instilled through the same needle. Osteomyelitis caused by streptococci may never suppurate. Those caused by staphylococci do so more consistently.

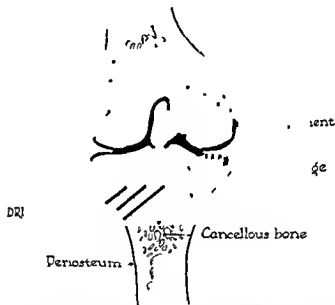


Fig. 110 Diagrammatic representation of the application of Stairs' method of drilling holes in the metaphysis in the surgical treatment of acute osteomyelitis.

If for any reason the abscess does not recede and increasing tension and pain indicate more adequate drainage, a simple decortication is done with as little trauma as possible, removing a small square of bone. No curettage or other manipulation is done. The periosteum should be cleanly incised and not stripped any further than is necessary to remove this section of bone. The wound is lightly packed with vaseline gauze and a plaster cast is applied.

Where effusion into the adjacent joint occurs, the joint should be aspirated to determine whether a pyarthrosis exists. If such is the case, the primary focus in the bone should be left alone and the joint drained surgically by adequate incision. The joint is lavaged with calcium

penicillin solution containing 250 units per cubic centimeter. Petrolatum gauze is inserted loosely into the wound, down to but not through the capsule. The wound is dressed and encased in plaster.

The subsequent care should be along the lines outlined by Orr. No windows are necessary in the casts and dressings should be done as infrequently as possible and always under strict asepsis. The wounds will take care of themselves.

BRODIE'S ABSCESS

Brodie's abscess is a chronic low grade localized infection in the

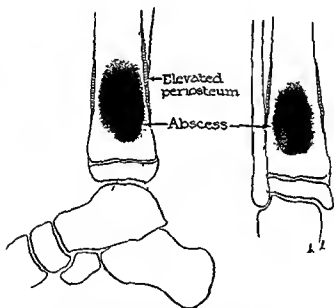


Fig. 111—Brodie's abscess of lower end of tibia

the tibia. It rarely produces a sinus, fistula or sequestrum. The chief symptom is a dull ache, which is worse at night and is sometimes referred to in children, as "growing pains." There may be a systemic reaction such as fever or leukocytosis. The roentgenogram reveals a sharp outline of the cavity which has lost its calcium salts, resulting in rarefaction.

The treatment consists in incision and curettage, the petrolatum gauze pack and immobilization in plaster.

CHRONIC OSTEOMYELITIS

While the outlook in the treatment of acute osteomyelitis presents a much brighter picture since the advent of the sulfonamides and penicillin, that in chronic osteomyelitis is still clouded. Bacteriostatic and bactericidal agents which must reach the involved bone by way of the blood stream are blocked by the barriers of avascular tissues. If necessary, surgical have been immeasurably aided by the availability of these potent chemotherapeutic

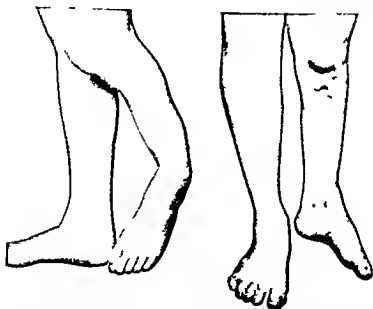


Fig. 112—Healed osteomyelitis due to compound fracture of tibia and fibula followed by nonunion, loss of much bone deformity and 4 inches of shortening. Amputation below knee.

agents, and surgical procedures may be carried out with impunity, which without their use would entail great hazard to life and limb.

In this discussion no differentiation will be made between chronic osteomyelitis representing the end stage of an acute hematogenous infection and that which may follow infected compound fractures or other bone infection produced exogenously. The problem is essentially the same and the vast experience gained during the World War II in the handling of chronic bone suppuration is applicable no matter what the source of the original infection.

Chronic bone suppuration with its attendant draining sinuses and

retained sequestra has always presented a distressing problem in treatment directed toward eradicating the infection. Unless this is accomplished drainage may persist for years with periods of complete or relative quiescence followed by recurrence. The attendant complications are ankylosis or stiffening of joints, atrophy of muscles, general debility with varying grades of secondary anemia and amyloid degeneration. In some cases the bone involvement is so widespread and the disability so great that amputation is the only logical recourse to the end that the patient may be returned to a useful existence. The application of chemotherapy in the form of sulfa drugs and penicillin has



Fig 113—Contracture of the knee following osteomyelitis of the tibia which produced suppurative arthritis of the knee

been disappointing. This was to be expected from the nature of the lesion. Chronically infected bone with its sinus tracts, dense areas of scar tissue, abscesses lined by chronic granulation tissue and surrounded by areas of eburnated bone presents a relatively avascular structure which cannot be effectively reached by substances introduced into the general circulation. However, our experience and the experience of many others in World War II has convinced us that chemotherapy is effective if locally one establishes free access to the general circulation and further provides conditions which prevent or mitigate against reinfection from without.

The problem of treatment resolves itself, therefore, along the following lines

- 1 Complete excision of the involved area including sinus tract, scar tissue, sequestra, and eburnated bone down to healthy vascular bone
- 2 Early obliteration of the defect created and/or closure of the wound
- 3 Application of chemotherapy before, during, and after surgery

Adequate Excision of the Involved Area.—The ramification and extent of sinus tracts may be visualized on x ray by the use of

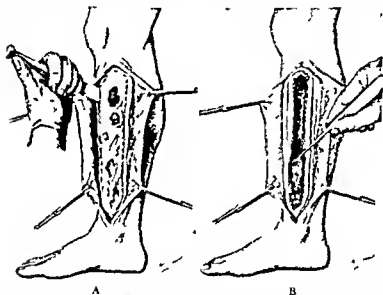


Fig 114—Extensive exposure of the shaft of the tibia in a case of chronic osteomyelitis with sequestra A Resection by chisel of the entire internal aspect of the tibia B, The tibia and its wide exposure and obliteration of sequestra and their fungous growths (P Lecene and P Juet. *Chirurgie des os et des articulations des membres* Paris, Masson et Cie)

radiopaque oil In addition or as a substitute method, methylene blue may be used at the time of operation by injection into the tract The stained areas will serve as a guide to the extent of excision A pneumatic tourniquet is used for hemostasis A liberal incision is made to expose the involved area, including for excision surface scars (Fig 114) All infected and scarred tissues are removed and the bone is chiseled away until vascular bone is encountered The shape of the defect left is not necessarily that of a saucer It should depend on the contemplated methods of secondary closure Whenever possible the infected area should be excised en bloc with as little stripping of nor

mal periosteum as possible. Excision having been completed, the tourniquet is released and hemostasis secured. At this point it is our practice to loosely pack the wound with petrolatum gauze and immobilize the limb in a cast including at least the joints above and below the involved area. Upon occasion we have sprinkled all interstices of the wound with penicillin sulfathiazole powder in proportion of 10 gms. of sulfathiazole to 50,000 units of penicillin before proceeding with the dressing. In some instances the wound has been loosely
t the
icen

Dressings are left undisturbed for a period of seven to ten days following which the wound is inspected and a method of closure determined.

Obliteration of the Defect and/or Closure of the Wound—In 1941 Dickson, Diveley and Kiene gave great impetus to the idea of primary closure of the wound following through debridement. The patient received sulfathiazole for five days preoperatively and the same drug was liberally dusted into the wound before closure (1 to 2 gm., using nasal insufflator). The administration of the sulfa drug was continued for an average of fifteen days postoperatively. In twenty two cases which averaged four, eight and ten years in duration, in eighteen the wounds closed by primary intent. In the eighteen cases closure occurred in fourteen in from one to two weeks. With the advent of penicillin this method has received even greater impetus. Following excision and debridement a certain proportion of cases will lend themselves to primary approximation of the wound edges. When this type of closure is contemplated the debridement must be to the nature of a sauceriza-

skin grafts. Before closure penicillin sulfathiazole powder may be dusted into the wound as outlined above. A small drain may be used for a few days. A compression dressing is applied and the limb put at rest in a plaster splint. While this method is quite feasible and in a good percentage of cases successful, we believe it is safer to delay closure following debridement for a period of seven to ten days. The wound is dressed at the end of this period and if clean granulating tissue is encountered closure may be done the following day, or if the wound requires further revision, this is done to insure ultimate successful closure.

In 1935 Lord called attention to the feasibility of closing osteomyelitic cavities by plastic methods. Following excision of scar tissue he used plastic flaps to close the defect primarily. It was his custom also to turn down flaps of muscle, fascia or fat into the cavity. He

closed the skin over all in one procedure. In some instances as in tibial defects the skin flaps were countersunk into the cavity and the skin

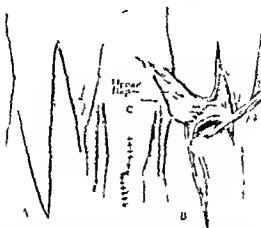


Fig. 115—Persistent cavity in upper end of tibia. A Flaps are outlined above and below and B turned into the excavated area securing a skin lined tract, C (Lord Surgery Gynecology & Obstetrics Vol 60 1935)

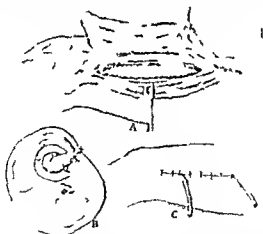


Fig. 116—Preparation of extensive cavity in femur and method of securing flaps (Lord Surgery Gynecology & Obstetrics Vol 60 1935)

edges fastened by means of carpet tacks or brads. Tubes were brought out through the wound for dakinization. By these methods he secured delayed primary union (Figs 115 and 116)

Fig 117



Fig 118



Fig 119



Fig. 117 -Osteomyelitis of tibia and femur eight months duration

Fig 118-Preoperative x rays

Fig 119 -Twenty five days after saucerization and skin grafting
(After Burgess and McClintock personal communication.)

Note The reader is referred to an article by Kelly Rosati and Murray in *Annals of Surgery* Vol 123 No 4 1945 p 688

Fig 120



Fig 121



Fig 122

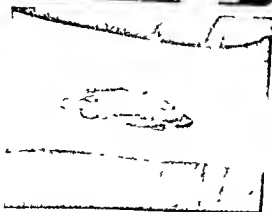


Fig 120 - Hematogenous osteomyelitis of tibia, seven weeks' duration

Fig 121 - Preoperative x ray

Fig. 122 - Twenty five days after saucerization and skin grafting
(After Burgess and McClintock personal communication.)

This type of procedure has found wide application with the advent of chemotherapy not only in the manner advocated by Dickson and his associates but also in the exteriorization and obliteration of bone cavities to be described below

Exteriorization of osteomyelitic cavities following debridement, by means of the direct application of split thickness skin grafts was extensively used during World War II and proved to be a reliable method of dealing with large defects which did not lend themselves to delayed primary closure or the shifting of skin flaps Following

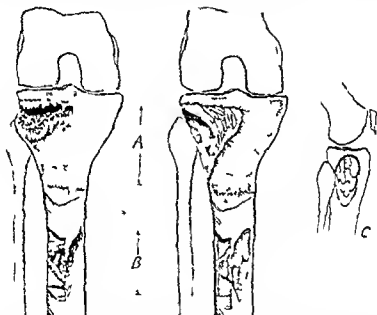


Fig 123—Shows two typical defects before and after excision and iliac bone graft A Coronal section of a large defect and detail of "bricking in" the iliac claps B Shows partial coronal section C, Sketch of lateral view showing the surface of the grafted area (Pirgge J Bone & Joint Surg, Vol. 28, 1946.)

débridement and saucerization a vaseloe pack dressing and cast were used for a period of seven to ten days following which the wound was redressed (Figs 117 to 122)

If a clean granulating bed presents itself a split thickness skin graft is applied to the wound surface and sutured into place The graft is perforated to allow for drainage A pressure dressing is applied

good many draining wounds incident to osteomyelitis attending missile inflicted compound fractures can be effectively dealt with in a much shorter period than is required with other methods of treatment

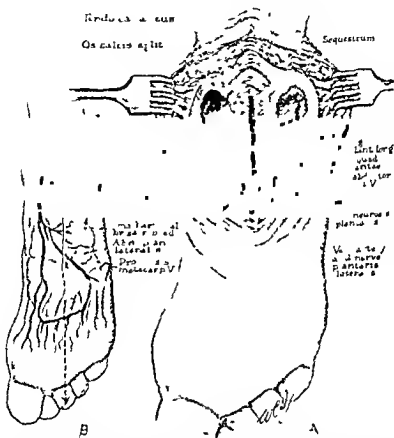


Fig 124 Operation for osteomyelitis of os calcis A Drawing from cadaver The bone lesion is schematic B Sketch showing line of incision and relation to plantar artery and nerve (Gaenslen F J J Bone & Joint Surg Vol. 13)

Recent reports by Prigge and by Coleman and his associates have dealt with the obliteration of bone cavities subsequent to the débride ment of chronic osteomyelitis by means of cancellous iliac bone im plants or muscle transplants. These authors have shown that following the extirpation of all avascular tissues from the infected bone, a recep

tive field is produced which with the employment of chemotherapy will permit the healing in of cancellous iliac bone. Prigge emphasizes that whenever possible a muscle flap transplant is preferable and will give greater assurance of healing. Shallow defects are obliterated by displacement of the adjacent muscles. Deeper hollows are dealt with by suturing a muscle flap into the depths of the defect. With a good vascular muscle flap coapted to a vascular bone bed and with adequate chemotherapy conditions for healing may be secured (Fig 123).

To summarize the methods outlined above it can be stated that foci of chronic osteomyelitis can be dealt with effectively by the elimination of avascular and infected tissue and early obliteration of the resulting defect.

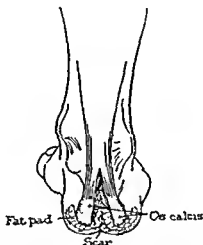


Fig 125—Operation for osteomyelitis of os calcis. Sketch showing scar partially retracted cleft resulting in two cushions well adapted for weight bearing without pain (Gaenslen F J J Bone & Joint Surg Vol. 13)

It is not implied that every chronic osteomyelitis can be dealt with by the methods outlined. Some cases are so extensive as to resist any surgical procedure but amputation and as Key has pointed out, such a solution may be desirable in the presence of severe, prolonged disability. Many cases are encountered which while not sufficiently disabling to indicate amputation are still so extensive as to make it impossible to contemplate any method of primary or delayed closure of the active area. Cases presenting extensive involvement of the entire shaft of a bone or the greater portion thereof with multiple draining sinuses may present insurmountable obstacles to the carrying out of the methods outlined above. These cases should be treated by following the principles outlined by Orr in 1923.

Orr Method.—This method has stood the test of time and forms the basis for much of the treatment already discussed. The following is an outline of the method in detail, taken verbatim from one of Orr's publications* on the subject

1 Preliminary

(a) Secure best position of the injured limb possible by traction, manipulation, etc.

(b) Use the simplest and least possible number of movements in reducing fractures or in correcting deformities

(c) Employ moleskin traction, pins or ice-tongs if found to be necessary, included in the cast to maintain length and correct position.

(d) Do not move or manipulate inflamed or injured parts during or following the operation.

2. The Operation

(a) Make an incision or opening that will thoroughly uncover (saucerize) the infected area

(b) Remove foreign material and dead or dying tissue as completely as possible.

(c) Do not curette or damage healing and protective portions of the wound cavity. No attempt is to be made to remove all diseased or infected tissue

(d) Do not remove bone or soft parts that may contribute to repair

(e) Wipe out with iodine and alcohol, just as the skin was prepared, in order to give a clean field for the dressing

3 The Closure

(a) Fill cavity with a vaseline gauze pack from the depths to the surface of the wound

skin

(e) Cover with a dry, sterile, absorbent pad to take up drainage at the edges of the vaseline pad

4 The Splint

(a) Maintain the length and position already obtained, and immobilize the affected part in such a manner that no muscle spasm or contracture can occur

(b) Plaster of Paris well fitting and extensive, has been found to be most satisfactory as an immobilizing device. Its efficiency has been greatly improved by the plan following

(c) Moleskin adhesive straps or skeletal fixation devices to be included in the cast will ensure fixed traction, control of fracture fragments and comfort for the patient.

5 The Dressing

(a) Plaster of Paris casts are applied so as not to be fenestrated or split. In this way the temptation to inspect or dress the wound is prevented

(b) Secondary dressings, when advisable, should be done in the operating room and aseptically

(c) The injured part is not to be moved nor the wound surface to be damaged.

* Orr, H. W. A New Method of Treatment for Chronic Infections Involving Bone. Nebraska State M. J. 8:50 1923

(d) Do not hesitate to employ anesthetics for secondary dressings

(e) Make late dressings as infrequently as early ones

REMARK One should immobilize (1) the wound, (2) the limb, (3) the patient.

Chemotherapy Before, During and After Surgery.—No hard and fast rules can be laid down but in general we have found that the following plan of treatment is adequate. Penicillin is given in doses of 30,000 units every three hours for a period of five days preoperatively. Upon the patient's return from the operating room we administer 50,000 units intravenously in saline. This is followed by 30,000 units intramuscularly every three hours for a period of three to five days postoperatively, being guided by the temperature reaction and blood count.

Penicillin and sulfathiazole powder is used locally following debridement in the proportion of 10 gm of the sulfa drug to 150,000 units of penicillin. When irrigation of the wound is deemed advisable postoperatively it is done through a tube leading into the gauze pack. A solution of calcium penicillin in distilled water is used. In certain cases a penicillin fast organism may be encountered which will respond readily to a sulfa drug. In such cases sulfadiazine may be used. Frequently it appears advisable to administer both drugs.

Streptomycin has not as yet been found to be beneficial in osteomyelitis.

It must also be remembered that an optimal time for surgery must be sought. Toward this end, the general condition of the patient must be brought up to the best possible level. *Blood transfusions* should be given to bring the red cell count and hemoglobin up and to supply immune bodies by passive transfer. Where the patient's nutrition is deficient an adequate intake should be assured, by a parenteral route if necessary.

Protein hydrolysates are available for intravenous administration. An adequate vitamin intake is necessary for the patient's general well-being, for bone repair, and for capillary formation. A high vitamin, high caloric diet is the rule when the patient can take it. The surgery of chronic osteomyelitis is not urgent surgery and the time spent in bringing the patient up to an optimum level is time well spent.



NONUNION IN FRACTURES

JAMES J. CALLAHAN, M.D., F.A.C.S.*

NONUNIONS have been of interest to me for many years. Why in identical fractures one patient should manifest a bony union and another should develop a nonunion is very perplexing. Various theories have been advanced, namely, soft tissue interposition, improper immobilization, and as so frequently stated by Dr. William R. Cubbins, a continuation of the force after the initial injury. All of the above deal with blood supply, soft tissue damage and interposition. Many authors have concluded their investigations of nonunions by saying that there was no evident reason why a patient did not secure a bony union except that the patient did not grow bone.

We normally have three sources of circulation of blood supply to the bone, namely, the periosteal, cortical and medullary circulations. Depending on the type of fracture involved, one, two or all three may be injured. Revascularization must necessarily await the recovery of the circulation in the adjacent involved soft tissues. Because of this one cannot say that a nonunion has occurred, but merely that there has been a delay in the normal healing time, which in a normal case might

and scar tissue is formed separating the bone ends and thus preventing close approximation. The result is a nonunion.

The fact that increased motion can and frequently does cause nonunions has been discussed by many authors. Fractures of the ribs and fractures of the clavicle violate the principle of rigid immobilization as these parts move approximately 35,000 to 40,000 times a day, yet nonunions rarely occur in these fractures. This is a difficult question to answer, and many theories have been propounded none of which can adequately explain this phenomenon.

GALLBLADDER FUNCTION AND NONUNION

After a careful search of the literature, I am unable to secure information or find any articles on the role of the gallbladder in relation to bone growth. However, it has been my observation in five cases that patients with cholecystitis with cholelithiasis fail to grow bone. This failure has been evident even after surgical intervention. In one case in particular, a fracture of the humerus, surgery had been per-

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formed three times using massive autogenous bone grafts after carefully preparing the fractured ends. In another, a fracture of the fore arm that failed to unite by the closed method was operated upon, but only united after cholecystectomy.

In the five cases observed blood studies, including calcium, phosphorus and cholesterol determinations, were made. Comparatively normal values were found with the exception that the phosphorus was slightly elevated in two of the cases. In all the cases roentgenographic examinations revealed gallbladder lesions with stones. Following cholecystectomy, bony union of the fractures occurred in two cases. It was necessary in the other three cases to reoperate on the fractures six to nine months following the cholecystectomy in order to secure bony union.

Every effort was made to secure a bony union in these patients from the time of the accident. This included rigid immobilization, correct diet, including di-calcium phosphate with viosterol, and all the known medications that might be of aid. Yet nonunions occurred. Surgery was not the answer, nor was bone grafting or plating.

I have searched through the histories of some nonunions of the neck of the femur, and have discovered that a large percentage of these patients also had gallstones. I realize that in fractures of the neck of

or cholelithiasis and just how much significance can be attached to this in relationship to the bony union.

These preliminary investigations have led me to the observation that the association of delayed unions or nonunions in fractures with disorders of the gallbladder and liver is far too common to be merely coincidental. I have come to believe that there exists a fundamental disturbance in the physiology of the biliary system which contributes to defective osteogenesis. The importance of calcium and phosphorus in bone formation has been the subject of study and investigation for many years. More recently the study has turned to the importance of vitamins and their role in the absorption and deposition of calcium and phosphorus. The realization of the role of vitamin D in bone growth revolutionized the treatment of rickets and the prevention of this deformity of childhood. The investigation of biliary disease associated with jaundice led to the conclusion that a diminution or absence of bile in the intestinal tract not only interfered with fat digestion and absorption but it likewise interfered with absorption and concentration of those vitamins which were fat soluble. This interference with the absorption particularly of vitamin D due to the diminution of adequate bile in the intestinal tract bears a direct relationship to calcium and phosphorus metabolism, delayed or prevented bone growth, re

generation and repair There is also some possibility and even probability that the diminished absorption of the fat soluble vitamin K has some influence on bone regeneration and repair

The absorption of vitamin K in adequate amounts from the intestinal tract is dependent on the presence of bile in the intestinal tract Vitamin K contains the essential building blocks of prothrombin which has an important part in blood clotting When bones are fractured and escape of blood occurs in and about the fracture it is essential that this blood produce a clot in other words a scaffold into which blood vessels may grow and nourish the osteoblasts and other osteogenetic cells which lay the foundation for bone regeneration and repair

CONCLUSION

In conclusion one may safely say that those dysfunctions of the biliary tract which disturb or diminish the flow of normal bile in nor
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ciated with the absorption and digestion of fats will likewise not find their way through the intestinal mucosa and into the liver where they could exert their influence in calcium and phosphorus metabolism The effect of diminished vitamin K may very likely have a contributory deleterious effect by interfering with proper clot stability and its definitive metaplasia of changing into bone callus and ultimately into compact bone

I offer this observation not as a conclusive finding on nonunions but as a theory that I believe should be taken into consideration in those patients who fail to grow bone Investigative studies are being conducted on this important subject and additional findings will be reported at a later date

FRACTURES INVOLVING THE ELBOW WITH SPECIAL REFERENCE TO THE HEAD OF THE RADIUS AND OLECRANON

JAMES J. CALLAHAN, M.D., F.A.C.S.*

FRACTURES involving the head of the radius and the olecranon have plagued the bone and joint surgeon for many years, and the correct treatment has always been a problem. Recently I have seen an increasing number of these fractures, many of which have marked deformity and disability as an end result.

In this serious type of fracture, it should be our aim to determine early whether surgical intervention or conservative treatment is to be used. If we select *conservative treatment*, the patient should be anesthetized and with the elbow at right angles and the forearm in supination, sufficient traction should be applied to relax the muscle spasm, reduce the partial dislocation and accurately reduce the fracture. In order to secure the reduction a posterior mold plaster of Paris cast should be applied using muslin bandage so as to secure a well fitting cast. This muslin bandage should be removed after a few hours and replaced by an elastic bandage, the advantage being that the arm and forearm can be rebandaged to accommodate for the reduction of swelling. This cast should be changed and a new posterior mold applied in the circular-urate ana-

limitation of motion in flexion, extension, pronation and supination.

One of the contributory causes for this limitation in motion is the long period of immobilization that is necessary before these patients secure a bony union. In the meantime, periarticular adhesions, myositis and other conditions develop. Therefore, it is my opinion that patients sustaining a fracture involving the head of the radius and the olecranon respond better to early *surgery*, with gentle removal of the head of the radius, care being taken to remove all of the small fragments in the antecubital fossa. This also affords the opportunity of repairing the orbicular ligament, if torn, and removing clots from the elbow joint. I recommend the use of a single incision starting on the posterior surface of the elbow, coursing laterally over the head of the radius, but there is no contraindication to making two incisions. Another advantage of surgery in this fracture is that an accurate reduction of the fractured olecranon can be made. This is accomplished

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by reducing the anterior displacement of the radius and ulna with the elbow in flexion, and by placing a rake retractor on the olecranon fragment so as to approximate this fragment to the ulna

The reduction should be secured by means of a long wood screw inserted through a longitudinal incision in the triceps tendon. A hole is usually started in the olecranon and the screw inserted through the fragment of the olecranon into the medullary canal of the ulna (Fig 117). This accurately immobilizes the fracture of the olecranon and can be utilized whether there is a comminuted or simple fracture, preventing anterior displacement of the forearm

By the use of this method, early motion of the elbow can be accomplished as it is only necessary to immobilize the fracture for approximately a week or ten days. Following this period, the posterior mold cast is removed, active motion started and, as an end result, this will give a far superior functioning elbow than any other method

I have been using this procedure for a number of years and am thoroughly satisfied. Its use is recommended because of the excellent end results. Roentgenograms of two typical cases are shown (Figs 126-129)

Fig 126—Comminuted fracture of the olecranon fracture of the head of the radius

Fig 127—Fragment of head of radius has been removed, fractured olecranon has been reduced and immobilized with screw

Fig 128—End result firm bony union—excellent flexion of elbow, limitation of 10 per cent in extension supination normal, loss of 10 per cent pronation. All of the above restrictions will improve with time

Fig 129—Similar case of comminuted fractures of the olecranon with fracture dislocation of the head of the radius. The radial head has been removed, comminuted fracture of olecranon reduced, and immobilized with screw. Note the bone growth on medial and lateral surfaces of the elbow, yet the patient has excellent flexion, loss of 20 per cent extension, limited pronation and supination

Fig 126



Fig 127



Fig 128



Fig 129



(For legends see opposite page)

The reduction should be secured by means of a long wood screw inserted through a longitudinal incision in the triceps tendon. A hole is usually started in the olecranon and the screw inserted through the fragment of the olecranon into the medullary canal of the ulna (Fig 117). This accurately immobilizes the fracture of the olecranon and can be utilized whether there is a comminuted or simple fracture, preventing anterior displacement of the forearm.

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Fig 126 - Comminuted fracture of the olecranon fracture of the head of the radius

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THE ESTIMATION OF WATER AND SALT REQUIREMENTS IN THE SURGICAL PATIENT

WILLIAM S. HOFFMAN, PH.D., M.D.*

UNDER normal circumstances the human organism has no difficulty remaining in water balance. Water is consumed in response to thirst, which is manifested by a sense of dryness of the mouth and pharynx. This sensation is produced when the water content of the body is less than normal, provided there has been no great loss of salt. It also occurs when the salt content of the body is greater than normal even without a loss of water. On the other hand, when large quantities of both water and salt have been lost from the body, the sensation of thirst may be blunted or abolished.

In surgery, problems of water and electrolyte balance frequently arise, not only because of interference with the normal intake of water and salt but also because of uncontrollably large losses of these constituents caused by the disease process or by the surgical management. The common problems usually fall into three categories: (1) the situation immediately following any major operation of a patient who has been in water and electrolyte balance up to the time of the operation, (2) conditions preoperatively and postoperatively in which the patient is in marked dehydration, usually with an accompanying acidosis or alkalosis, as a result of large fluid losses by vomiting, diarrhea, fistula drainage or exudation, (3) losses of fluids induced postoperatively by the requirements of suction drainage of the intestinal tract. The management of some of these problems and the principles involved in such management will be briefly considered and illustrated in this paper.

FLUID REQUIREMENTS FOLLOWING UNCOMPLICATED MAJOR SURGICAL OPERATIONS

The normal intake and output of water varies of course with the food habits of the individual and the temperature and humidity of the environment. But the pattern shown in Table I for an average person in temperate climate gives some idea of the magnitude of the quantities involved.

Of the items of water output, that of insensible perspiration is the most constant since it is a function of the total energy output of the body. The energy required for the vaporization of 1000 cc. of water is

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about 24 per cent of the heat produced by the entire body. The amount of water excreted in the form of sweat is

and fairly constant in quantity in conditions of average temperature and humidity. At the time of operation, this quantity may be markedly increased because of the higher temperature of the operating room and the use of blankets. It should be remembered that the water of sweating contains a concentration of salt comparable with that of plasma and other extracellular fluids.

It is the quantity of water for urine formation which is most elastic. The quantity of water available to excrete the nitrogenous and other waste products is the difference between the sum used in other water excretions and the total intake. For a constant intake the more water

TABLE 1 —AVERAGE DAILY WATER BALANCE OF NORMAL ADULTS

Intake		Output	
Water and other beverages	1200 cc	Urine	1500 cc
Water of solid foods (about 70%)	1500 cc	Feces	200 cc
Water of oxidation (about 12 cc. per 100 calories)	300 cc	Sweat	300 cc
Total	3000 cc	Insensible Water Loss	
		Skin	400 cc
		Lungs	300 cc
		Total	3000 cc

average of about 1500 cc. The average specific gravity for such urine is about 1.015. A minimum of 500 cc. is required to excrete the urea and

it can be seen that an adult patient who has just been operated upon and who cannot take fluids by mouth will require about 3000 cc. of water for the twenty-four hours following operation and from 2500 to 3000 cc. for each succeeding day. This must be given parenterally. The amount of salt required for this 3000 cc. will depend almost entirely upon the amount lost in the sweat, for there is under normal circumstances, very little salt lost in the urine if there is no intake of it. The amount of salt required is seldom more than 9 gm. and may be only half that quantity. Thus a satisfactory regimen for the postoperative period is 2 liters of 0.45 per cent saline in 25 per cent dextrose solution and 1 liter of 10 per cent dextrose solution.

If the patient has some protein deficiency a 5 or 6 per cent amino

acid solution that is, a protein hydrolysate, in 5 per cent glucose can
 be given in the 10 per cent glucose solution. On the second or

and the remaining fluids may be given as usual. The test of the proper quantity is the clinical condition of the patient and the excretion in twenty four hours of 1000 to 1500 cc of urine of a specific gravity of 1.015 or less.

Coller and his co-workers¹ have justifiably called attention to the serious risk of giving too much salt to the undehydrated patient who has just been operated upon. If the 3000 cc of fluid required per day were given as physiological saline solution the patient would be getting 27 gm of salt a day, a far greater dietary intake, which is 5 to 10 gm, than a good portion of this salt solution will be lost in the body. Since some of the water of this solution is lost as insensible perspiration and as urine the sodium content of the extracellular fluids will be abnormally high. To compensate for this phenomenon water will be drawn out of the cells to dilute the extracellular sodium solution and as Darrow² has recently demonstrated, some sodium will be forced into the cells of muscle, brain and other tissues displacing potassium and causing damage. If, on the other hand, as saline solution is given, extra water is

available for urinary excretion and can carry with it any excess of sodium and chloride. The important fact to bear in mind is that post operative fluids in the usual cases are being furnished not to replace water and salt lost in dehydration but merely to maintain by parenteral means a previously adequate water and electrolyte equilibrium.

DEHYDRATION, ACIDOSIS AND ALKALOSIS IN SURGERY

Surgical conditions, particularly those involving the gastrointestinal tract, may at times involve very large losses of fluid and salt. These cases require an entirely different management from that discussed heretofore. In the case of severe dehydration, faced with a case of severe dehydration, the patient unavailingly only with large quantities of dextrose solution. Such a patient may have a deficiency of extracellular fluids (including plasma) with an electrolyte content equal to that of 5 or 6 liters of saline solution. If such quan-

about 24 per cent of the heat produced by the entire body. This 1000 cc. of water is lost in the form of sweat. The water of sweating contains a concentration of salt comparable to that of plasma.

Because of the higher temperature of the operating room and the use of blankets, it should be remembered that the water of sweating contains a concentration of salt comparable to that of plasma. The water of sweating is most elastic, and other excretions and the total intake. For a constant rate of water

TABLE I—AVERAGE DAILY WATER BALANCE OF NORMAL ADULTS

Intake		Output	
Water and other beverages	1200 cc	Urine	1500 cc
Water of solid foods (about 70%)	1500 cc	Feces	200 cc
Water of oxidation (about 12 cc per 100 calories)	300 cc	Sweat	300 cc
Total	3000 cc	Insensible Water Loss	
		Skin	700 cc
		Lungs	300 cc
		Total	3000 cc

average of about 1500 cc. The average specific gravity for such urine is about 1.015. A minimum of 500 cc. is required to excrete the urea and other nitrogenous constituents formed during the twenty-four hours. If such a quantity is unavailable, nitrogenous retention will occur even in the presence of unimpaired renal function.

Postoperative Regimen.—With these considerations in mind, it can be seen that an adult patient who has just been operated upon and who cannot take fluids by mouth will require about 3000 cc. of water for the twenty-four hours following operation and from 2500 to 3000 cc. for each succeeding day. This must be given parenterally. The amount of salt required for this 3000 cc. will depend almost entirely upon the amount lost in the sweat, for there is, under normal circumstances, very little salt lost in the urine if there is no intake of it. The amount of salt required is seldom more than 9 gm. and may be only half that quantity. Thus a satisfactory regimen for the postoperative period is 2 liters of 0.45 per cent saline in 2.5 per cent dextrose solution and 1 liter of 10 per cent dextrose solution.

If the patient has some protein deficiency a 5 or 6 per cent amino

side producing a dehydration with no change in the carbon dioxide combining power

The quantities of fluid that may be lost in gastrointestinal disturbances can be visualized by a recognition of the magnitude of the daily gastrointestinal secretions as shown in Table 2. The quantities may be even larger in the presence of inflammation. Under normal conditions the 8000 cc. or more of gastrointestinal juices (which are practically isotonic with plasma) are reabsorbed in their passage through the small and large bowel leaving only about 200 cc. in the feces. In protracted vomiting, diarrhea or drainage it will not take long for fluid loss of 5 or 6 or more liters to be produced.

Diagnosis of Dehydration—The symptoms of dehydration are usually not difficult to recognize. The patient shows a dryness of the mouth and tongue, shocklike weakness and apathy, diminished skin turgor, sunken softened eyeballs, lowered blood pressure associated frequently with a rapid pulse rate and other signs of circulatory distress and marked diminution in urinary output which occasionally

TABLE 2—AVERAGE VOLUME OF DAILY GASTROINTESTINAL SECRETIONS

Saliva	1500 cc.
Gastric secretions	2500 cc.
Bile	500 cc.
Pancreatic juice	700 cc.
Intestinal juices	3000 cc.
Total	8200 cc.

approaches anuria. If alkalosis is present the breathing may be shallow. If the patient is in acidosis

— — — — — are diagnostic of the condition especially if cognizance is taken of the history and the physical findings. The urine is scanty and of dark color with a high specific gravity. If the condition however has been extended to the point of breakdown of renal function the urine may be pale and of low specific gravity as in nephritis. The urine may contain albumin and casts. The blood shows elevation of urea nitrogen and nonprotein nitrogen concentration which are usually moderate but at times may be marked. The nonprotein nitrogen may be 100 mg. per 100 cc. or higher and the condition may be confused with an uremia on a nephritic basis. The creatinine concentration is also elevated but seldom to the degree of that of the nonprotein nitrogen. The serum phenol and indican tests are usually negative which may help distinguish the condition from chronic nephritis.

The most significant serum findings are the concentrations of chloride and sodium and the carbon dioxide combining power. The chlo-

courageous management is possible only if the principles of water and electrolyte balance and the factors producing a disturbance in that balance are understood.

Principles of Water and Electrolyte Balance and Causes of Dehydration.—The normal adult body contains about 14 liters of extracellular fluids, of which about 3.5 liters is the circulating plasma. This solution has the same hydrogen concentration and the same osmotic pressure as the fluid in the cells of the body. Any marked lowering of the osmotic pressure of the extracellular fluids would be accompanied by increase of the water content of the cells with a consequent swelling of the cellular water and damage to their vital activity. The bodily mechanisms are geared to guard the tonicity of the extracellular fluids. The main cation responsible for the extracellular fluid osmotic pressure is sodium which is present in concentrations of about 330 mg. per 100 cc (or 143 mEq per liter) as measured in the plasma. The chief anion is chloride which is present in smaller quantities than sodium or about 105 mEq per liter. When the chloride content of the plasma is measured as sodium chloride, the normal concentration is 575 to 630

lar fluids is diminished, its concentration is still normal. If, however, sodium and chloride continue to be lost, the water loss does not keep pace with the loss of electrolytes. By the time dehydration is severe not only is the quantity of extracellular fluids markedly diminished but the concentration of sodium and of chloride is much lower than normal. This is the perilous state

, protracted vomit
ever dehydration
all as malnutrition

because of lack of intake. Pyloric obstruction produces severe dehydration not merely because of limited intake but because of loss of gastric juice by vomiting. From the point of view of water and electrolyte balance, gastric juice can be considered a fluid containing water, sodium chloride and hydrochloric acid. The loss of such fluid can in a few days produce marked dehydration. Since the chloride loss is greater than the sodium loss, there is relatively more base left as alkali reserve. In other words, the patient will be in alkalosis.

In low intestinal obstruction, in fistula drainage and in diarrhea, the fluid lost can be regarded as a mixture of water, sodium chloride and sodium bicarbonate. In these cases dehydration is usually accompanied by a greater loss of sodium than chloride. The patient is then in acidosis. At times the loss of sodium is comparable with that of chlo

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cc, instead of being normal, is actually very low and indicates marked dehydration. The failure to recognize this fact has in many instances invited disaster. It would be better to abandon whole blood chloride determinations altogether and substitute serum chloride determinations. But where whole blood chloride determinations are carried out, the expected normal range should be estimated from a chart such as Table 3 as developed in a previous paper.⁴

Illustrative Cases.—The following two cases illustrate the abnormal findings in dehydration and the restoration with adequate administration of water and saline.

CASE I—R. R., a white man of 59, had been readmitted to the hospital three weeks after an ileostomy for obstruction from adhesions following an operation

usions) The serum
The serum sodium
dioxide combining
nonprotein nitrogen
800 cc in spite of
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centration. During these five days in spite of large amount of drainage from the
ly with a specific
ogenous products
per 100 cc. The
serum sodium and chloride and carbon dioxide combining power were restored to
normal levels

Despite the low serum protein concentration, the patient showed no peripheral or visceral edema as a result of the large infusions. However had the serum protein level been a little lower, there might have been an attendant edema which might have limited the diuretic effect of the injections. Rhoads⁵ has called attention to the fact that when the protein level is very low patients with oliguria because of dehydration may not obtain good diuresis and restoration of serum chloride and sodium to normal on injection of saline solution. Instead, the fluid and salt are distributed into the tissues as edema fluid, and the blood vol-

ride concentration is usually markedly depressed below the lower limits

may fall to levels of 20 cc per 100 cc. In other cases of dehydration, the fall in serum sodium concentration parallels that of the chloride, and the carbon combining power may be within normal limits.

TABLE 3—VARIATIONS OF WHOLE BLOOD CHLORIDE WITH THE HEMOGLOBIN CONCENTRATION AND RED BLOOD CELL VOLUME IN BLOOD OF PATIENTS WITH NO ELECTROLYTE BALANCE

Hemoglobin (gm per 100 cc)	Hematocrit % R.B.C.	Whole Blood Chloride	
		Range of Normal (mg NaCl per 100 cc)	Expected Mean (mg NaCl per 100 cc)
13-16	40-47	456-509	479
11-13	35-40	474-526	497
9-11	30-35	491-544	514
8-9	25-30	503-555	532
7-8	20-25	520-573	544
3-7	10-20	532-602	567
0 (Serum)	0	585-643	608

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concentration is the best criterion for dehydration, for it is almost invariably lower than 138 mEq per liter. It should be recognized that by the time the sodium concentration is noticeably lower than normal, the patient has already lost considerable water, probably more than 3 liters.

The determination of whole blood chloride is usually misleading in the information it imparts concerning the state of hydration, for the

the hemoglobin concentration and hematocrit are normal, in severe

urine does not come up to normal. Such patients should receive large quantities of plasma and/or parenteral amino acids along with the saline solution. The development of edema especially in the lungs should be the warning signal that the quantity of saline infusion is too great.

CASE II—F. S. a white woman of 49 who had been operated on for a pseudocyst of the pancreas following trauma. Had a draining pancreatic fistula. She had vomited frequently before and after the operation and had taken little food. She was weak, had poor appetite, headaches and recurrent vomiting. The urine was scanty and concentrated. The blood chemical findings given in Table 4 show an

accumulated nitrogenous end products and a consequent restoration of the blood chemical picture to normal. The patient's symptomatic condition improved correspondingly. During the ensuing week the patient showed even greater improvement on a high protein therapy.

Comment on Cases I and II.—These two cases are unusual in that the syndrome of dehydration and azotemia had developed slowly and insidiously. The condition in both cases might not have been recognized except by the adequate blood chemistry. In an acute case, such as that of intestinal obstruction as recently reemphasized by Ireneus³ the symptoms of dehydration may develop overwhelmingly rapidly and require prompt and bold treatment if disaster is to be avoided.

FLUID REQUIREMENTS IN CASES OF SUCTION DRAINAGE

The modern treatment of distention of the small intestine by suction drainage with a Levin tube in the duodenum has induced new problems of water and salt management. Not only do patients under such a

daily requirements and to permit an adequate flow of urine. The general rule than can be laid down is that the quantity of fluid withdrawn should be administered intravenously in the form of physiological saline solution and that in addition 2000 to 3000 cc. of 5 per cent dextrose or amino acids in dextrose be given.

The test of a satisfactory control should be the excretion of 1000 to 1500 cc. of urine daily and the finding of normal levels of serum chloride, carbon dioxide combining power and nonprotein nitrogen. If serum sodium determinations can be made along with these other analyses it should not be difficult to assay accurately the patient's water and electrolyte situation and to make the proper adjustments. There is the danger of overzealous treatment, especially in the pres-

TABLE 4—CHEMICAL FINDINGS IN TWO CASES OF DEHYDRATION IN SURGICAL PATIENTS

Date	Plasma Vol (cc)	Hematocrit (%)	Total Protein (gm per 100 cc.)	Albumin (gm per 100 cc.)	N P N (mg per 100 cc.)	Sodium (mEq per L.)	Chloride (mEq per L.)	CO ₂ Comb. Power (cc per 100 cc.)	Urine (cc per 24 hrs.)	Drainage (cc per 24 hrs.)	Nitrogen Excretion (gm per 24 hrs.)
Case I R.R. June 2	2174	62	6.60	3.38	180	132	79	86	800	1,030	8.1
3									630	730	7.9
4									600	1300	8.3
5									2200	136	22.9
6									2300	410	21.2
7									1120	1280	17.9
8	3117	41.5	5.23	2.98	33	110	104	64	1290	1300	14.9
Case II P.S. Aug 10	1370	28	6.15	5.07	129	127	100	50	630	370	5.3
11									650	1200	5.8
12									1600	1300	18.3
13									2230	1000	22.1
14	2083	52	6.60	3.84	50	212	408	58	1300	420	15.0
21	2098	16.5	6.71	4.51	38	113	100	60			

ume does not come up to normal. Such patients should receive large quantities of plasma and/or parenteral amino acids along with the saline solution. The development of edema especially in the lungs should be the warning signal that the quantity of saline infusion is too great.

CASE II—F S, a white woman of 49 who had been operated on for a pseudocyst of the pancreas following trauma, had a draining pancreatic fistula. She had vomited frequently before and after the operation and had taken little food. She was
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alone would have given no indication of the dehydration, but the serum sodium correctly demonstrated the condition. The patient was given 7 liters of 0.45 per cent saline in 2.5 per cent dextrose during the next three days, along with fluids and salt by mouth. There was a copious diuresis with rapid excretion of the accumulated nitrogenous end products and a consequent restoration of the blood chemical picture to normal. The patient's symptomatic condition improved correspondingly. During the ensuing week the patient showed even greater improvement on a high protein therapy.

Comment on Cases I and II—These two cases are unusual in that the syndrome of dehydration and azotemia had developed slowly and insidiously. The condition in both cases might not have been recognized except by the adequate blood chemistry. In an acute case, such as that of intestinal obstruction, as recently reemphasized by Ireneus,³ the symptoms of dehydration may develop overwhelmingly rapidly and require prompt and bold treatment if disaster is to be avoided.

FLUID REQUIREMENTS IN CASES OF SUCTION DRAINAGE

The modern treatment of distention of the small intestine by suction

of this lost
o meet the
The gen-
eral rule than can be laid down is that the quantity of fluid withdrawn should be administered intravenously in the form of physiological saline solution and that in addition 2000 to 3000 cc. of 5 per cent

carbon dioxide combining power and nonprotein nitrogen. If serum sodium determinations can be made along with these other analyses, it should not be difficult to assay accurately the patient's water and electrolyte situation and to make the proper adjustments. There is the danger of overzealous treatment, especially in the pres

ence of hypoproteinemia. Unnecessarily large quantities of fluid not only produce the risk of edema but also burden the heart. Frequent blood chemical analyses made by a reliable technician should be resorted to during the entire period of Wangenstein drainage.

SUMMARY

Problems of water and electrolyte balance in surgery require for their solution an understanding of the physiological principles of water and salt metabolism. For the maintenance of the postoperative patient not in dehydration about 3000 cc of water must be furnished daily, only a small portion of which need be in the form of saline, or excess, and by proper chemical analyses prompt and courageous treatment with intravenous salt solution is vital. Special precautions must be taken in the presence of hypoproteinemia. Suction drainage of the intestinal tract requires the replacement of the removed fluid by intravenous saline injections in addition to the normal daily requirements of fluid.

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SYMPOSIUM ON GASTROINTESTINAL SURGERY

RALPH COLP, M D, *Consulting Editor*

A RATIONAL APPROACH TO THE SURGERY OF HIGH GASTRIC ULCER

RALPH COLP, M D, F A C S * AND
LEONARD J DRUCKERMAN, M D, F A C S †

WE wish to present a simple yet successful operative therapy for chronic benign gastric ulcers situated high on the lesser curvature of the stomach, and those juxta esophageal in position. The method is not new, but after a trial period in this clinic demonstrated its effectiveness, it has been used with increasing frequency.

It is important to understand that these high lying benign ulcers have presented such grave technical problems in their surgical management that a multiplicity of procedures have been advocated. Initially, these operations were designed to relieve the gastric retention which occurred from a reflex pylorospasm. The results of the best of these operations, gastroenterostomy, were poor, whether or not the local lesion was simultaneously excised. Although motor disturbances were partially corrected, no permanent reduction in gastric acidity resulted, and it must be evident that acidity is more fundamental in the pathogenesis of ulcer than are motor disturbances. Pyloroplasties were tried and found wanting. Lesser curvature or

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gastric resection" Since then numerous European surgeons have reported their experiences with this procedure. It must be stressed that it is applicable only in those cases in which the ulcer occupies the upper third of the stomach so that approximately one half to two-thirds of the stomach distal to the lesion may be resected. This will naturally restrict the field of "palliative gastric resection" to (1) juxta esophageal ulcers and peptic ulcers of the esophagus, (2) high lesser curvature ulcers, and (3) these penetrating ulcers situated high on the posterior wall of the cardia in which the general physical condition of the patient does not warrant the operative trauma of a subtotal gastrectomy with the removal of the ulcer.

The operation is best performed under spinal anesthesia. The usual midepigastric incision is made from the ensiform cartilage to the umbilicus. The stomach is then carefully examined to determine the extent and nature of the lesion. The gastric lymph nodes and liver are palpated for evidences of metastases. If there is doubt as to the benign nature of the ulcer, the lesion may be visualized through a gastrotomy, and, if necessary, a specimen removed for immediate pathologic examination.

The technique of palliative gastrectomy is similar to that employed for a retrograde subtotal gastrectomy. The right gastric vessels are ligated distal to the pylorus, and at a point opposite, close to their origin, the right gastroepiploic vessels are divided. The duodenum is then sectioned just distal to the pylorus, closed in layers, and buried against the head of the pancreas. The pyloric end of the stomach is reflected to the left and the gastroduodenal omentum is divided. This gives an excellent exposure of the lesser omental sac, and any attachments of the posterior wall of the stomach to the pancreas. The left gastroepiploic vessels are divided at the point of proposed resection, and the left gastric artery is ligated distal to the ulcer or at the celiac axis, if necessary. After this mobilization, one may determine whether it is more expedient to include the ulcer in the resection or simply perform a palliative gastrectomy. A De Pez clamp is then applied and the resection completed. Gastrointestinal continuity is restored by an isoperistaltic termolateral gastrojejunostomy of the Hofmeister type made anterior to the colon. The abdominal incision is closed with interrupted buried steel wire.

Although certain complications have been attributed to leaving the ulcer in situ, most of them are fortunately rare and give little cause for concern. It has been stated that the reduction in acidity decreases its bactericidal effect and that the infection present in these

sleeve resections were not only technically quite difficult but failed to result in permanent cure. Total gastrectomies have been performed, but it is questionable whether an operation of this magnitude, with its attendant high mortality rate and subsequent invaliding of the patient, is ever indicated for benign disease.

Supradiaphragmatic vagotomy would appear to have no place in the therapy of gastric ulcer, for no opportunity is afforded to examine the lesion locally and dismiss the ever present suspicion of carcinoma. Infradiaphragmatic vagotomy, because of the edema and induration in the region of the esophagus, would be technically hazardous. Physiologic rest for the stomach has been attained, to a degree, by performing a jejunostomy for alimentation, but its benefits have been proved to be temporary in nature. However, it still is very useful as a preliminary procedure in those cases in which a massive ulceration with extensive inflammatory exudate and adherence to other organs preclude immediate gastric resection.¹ Innumerable modifications of subtotal gastrectomy have been described for the removal of high lying ulcers,² leaving a patent esophagus and enough of the fundus to effect a gastroenteric anastomosis.

After reviewing these operations, it becomes quite apparent that they are technically difficult, and frequently unsuccessful. There is one operation, however, which in the light of gastric physiology seems to be rational, and worthy of clinical application. The successful understanding of the procedure seems to depend on certain clinical facts. Chemical analyses of test meals performed on patients who have had a subtotal gastrectomy for gastric ulcer reveal an achlorhydria in well over 95 per cent of the cases.³ When this operation is performed for ulcers situated at or above the reentrant angle, an achlorhydria results in practically 100 per cent of the cases. In the absence of free acid, gastric and gastrojejunal ulcers do not develop. What would be the result, then, if in these high lying gastric ulcers an adequate subtotal gastrectomy could be performed below the lesion, leaving the ulcer in situ? Would achlorhydria result? Clinical experience has shown that an anacidity ensues, and has demonstrated that these ulcers not only heal rapidly in an anacid stomach but do not recur.

Madelener,⁴ in 1923, reported the first successful cases of high lying gastric ulcers which completely disappeared following a simple pylorotomy followed by a Billroth I anastomosis. Florcken subsequently performed a subtotal gastrectomy of the Billroth II type, distal to the ulcer, which he did not remove, and called the procedure palliative.

There was one postoperative death which occurred within twenty-four hours after operation, and was apparently due to an acute coronary thrombosis.

The surviving patients have *all* been studied often in the Follow-Up Clinic of Mt Sinai Hospital. In the more recent cases only short periods of observation have been possible, but the majority of cases have been followed for more than five years (Table 1). All patients have been relieved of gastric symptoms and have gained weight. Rehfuess test meals (specimen taken every fifteen minutes during a two hour period) disclosed a complete absence of free hydrochloric acid in every specimen. Most patients have had these tests repeated with similar results. Repeated roentgenographic and gastroscopic studies have failed to disclose any pathologic processes, except in Case 8, in which there was evidence of fibrous narrowing at the ulcer site. This patient died twenty-one months after operation from uremia and pneumonia, and autopsy disclosed a completely healed ulcer site. The patients who survived have not only remained ulcer-free, but inasmuch as the repeated meals have shown a persistent achlorhydria, it may be expected that they will remain so.

The first eight cases were previously reported.¹ Two additional cases are herewith appended.

Case No 9

I L., a 59 year old white man, was first admitted on January 11, 1940, complaining of epigastric discomfort of sixteen months' duration. Ingestion of food had produced transient relief, medication had had no effect on the pain. About fourteen months prior to admission he had had two tarry stools but had not noticed any weakness or pallor following this. X-ray examination of the gastrointestinal tract had failed to visualize any pathologic changes. The patient had lost 11 pounds during his illness. The past history was noncontributory.

Physical examination disclosed a thin, asthenic male. There was moderate peripheral sclerosis. There was some reduplication of the first heart sound at the apex. The blood pressure was 96/60. Slight midepigastric tenderness was present, no mass could be palpated. The patient weighed 108 pounds.

The urine was negative. The hemoglobin was 81 per cent (Sahli). The white count was 11,800 and the differential count was normal. The blood chemistry was reported as follows: urea, 18 mg per 100 cc., chlorides, 597 mg per 100 cc., the carbon dioxide combining power, 51.6 volumes per cent, and the total proteins, 7.6 gm per 100 cc. The Wassermann test was negative. The Rehfuess test meal disclosed a free acidity of 48 millimols and a combined acidity of 114 millimols. The stool did not contain occult blood.

Gastrointestinal x-ray (performed before admission and reviewed in the hospital) disclosed a constant patch of barium measuring 1 by 1.5 cm., on the pos-

large callous ulcers may increase and lead to perforation and bleeding. Occasionally, a profuse diarrhea possibly related to the sudden achlorhydria has been described. Cicatricial contraction incident to healing of the juxta-esophageal ulcers has caused a degree of esophageal stenosis. The only possibility which remains a constant source of worry is the possible misinterpretation of the pathologic findings. Among the earliest cases treated by the so called palliative partial gastrectomy, a few were subsequently proved to have been carcinoma. This remains an ever present hazard. Yet it must be admitted that the immediate and ultimate results of a total gastric resection for a penetrating carcinomatous ulcer of the cardia are so poor that the

TABLE I

SUMMARY OF FINDINGS AND RESULTS IN TEN CASES OF HIGH LYING CHRONIC GASTRIC ULCER TREATED BY PALLIATIVE PARTIAL RESECTION

Case No	Age	Size in Cms of Resected Specimen		Preop Acidity		Postop Acidity		Follow Up Years and Months
		Lesser Curvature	Greater Curvature	Free	Comb	Free	Comb	
1	55	14	16	62	74	0	34	7 years 0 months
2	50	11	17	40	68	0	8	8 " 3 "
3	58	9	14	70	84	0		8 " 3 "
4	54	8	17	55	80	0	14	6 years 7 months
5	61	7	19	65	90	0	30	5 " 4 "
6	53	8	21	2	15	0	20	5 " 2 "
7	54	3	19	20	55	0	10	2 " 11 "
8	60	8	20	30	55	0	16	1 " 9 "
9	59	9	19	48	114	0	26	8
10	63	5	14	10	24	0	20	5

error of performing a total gastrectomy for benign ulcer is decidedly worse than that of performing a palliative gastrectomy for a high lying malignant ulcer.

During the past nine years, palliative partial gastrectomy has been performed on ten patients.^{8, 7} All were over fifty years of age and in poor general condition. Some patients had had repeated courses of medical treatment, with little or no relief, others were suspected of having malignant disease of the stomach and exploratory surgery was done soon after their admission. Eight patients had normal or elevated free and combined acid figures in the Rehfuess test meal, low figures were obtained in two patients.

There was one postoperative death which occurred within twenty-four hours after operation, and was apparently due to an acute coronary thrombosis.

The surviving patients have *all* been studied often in the Follow Up Clinic of Mt. Sinai Hospital. In the more recent cases only short periods of observation have been possible, but the majority of cases have been followed for more than five years (Table 1). All patients have been relieved of gastric symptoms and have gained weight. Rehfuss test meals (specimen taken every fifteen minutes during a two-hour period) disclosed a complete absence of free hydrochloric acid in every specimen. Most patients have had these tests repeated with similar results. Repeated roentgenographic and gastroscopic studies have failed to disclose any pathologic processes, except in Case 8, in which there was evidence of fibrous narrowing at the ulcer site. This patient died twenty-one months after operation from uremia and pneumonia, and autopsy disclosed a completely healed ulcer site. The patients who survived have not only remained ulcer-free, but inasmuch as the repeated meals have shown a persistent achlorhydria, it may be expected that they will remain so.

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spherical sclerosis. There was some reduplication of the first heart sound at the apex. The blood pressure was 90/60. Slight midepigastria tenderness was present. No mass could be palpated. The patient weighed 106 pounds.

The urine was negative. The hemoglobin was 81 per cent (Sahli). The white count was 11,800 and the differential count was normal. The blood chemistry was reported as follows: urea, 18 mg per 100 cc., chlorides, 597 mg per 100 cc., the carbon dioxide combining power, 51.6 volumes per cent, and the total proteins, 7.6 gm per 100 cc. The Wassermann test was negative. The Rehfuss test
114 ml

the hos-
the pos-

tenor wall of the stomach just below the cardia. On two films a suggestion of a filling defect was seen just about this patch.

Gastroscopy visualized an ulcer about 2.5 cm. in size, on the posterior wall of the stomach, just below the cardia. The base was gray and irregular. The lesion was suggestive of a malignant ulceration.

An exploratory operation was done on January 17, 1946, under continuous spinal anesthesia. About 1 inch below the cardio-esophageal junction, on the lesser curvature and posterior wall, was an obviously benign ulcer about 3 cm. in size. A typical palliative gastrectomy was performed, the gastric ulcer being left in situ, and gastrointestinal continuity was restored by an antecolic gastrojejunostomy of the Hofmeister type.

The resected specimen measured 9 cm. on the lesser curvature and 19 cm. on the greater curvature. The microscopic examination disclosed chronic and acute gastroduodenitis. No ulcer or tumor was found in the specimen.

The postoperative course was uneventful. X-ray examination of the stomach on the eleventh postoperative day failed to disclose any evidence of the previously seen ulcer. Gastroscopy on the fifteenth postoperative day disclosed the ulcer to be about one third its former size. It appeared quite shallow, had a white base and sharp edges. The ulcer now appeared to be rapidly healing and benign. A Rehfuess test meal on the twenty first postoperative day disclosed no free acid, and a combined acidity of 32 millimols.

The patient was seen repeatedly in the Follow Up Clinic. He was last seen on September 11, 1946, at which time he was in excellent health, and had gained 10 pounds. Gastroscopy performed on May 6, 1946, failed to disclose any evidence of the previous ulceration. X-ray examination on May 20, 1946, failed to disclose any ulceration. A Rehfuess test meal on May 27, 1946, was reported as containing no free acid, and a combined acid of 26 millimols.

Case No 10

C. B., a 63 year old man was admitted on April 12, 1946, complaining of epigastric pain of four months duration. The pain radiated to both shoulder blades, was somewhat worse at night, and had been accompanied by progressive anorexia and a weight loss of 30 pounds. The patient had not noticed any relief of his pain following the ingestion of food. He had a cholecystectomy in 1929.

Physical examination revealed a rather emaciated, chronically ill, old man. The heart was enlarged and a systolic murmur was present at the apex. There was moderate peripheral sclerosis. The blood pressure was 126/70. The abdomen was tender and somewhat spastic in both upper quadrants. The lower abdomen was nontender and soft. The liver could be felt about 8 cm. below the costal border. Rectal examination disclosed a markedly enlarged prostate. Neurological examination was essentially negative.

The patient weighed 126 pounds. The urine was negative. The hemoglobin was 75 per cent, the white blood count was 9600 and the differential count was normal. The blood chemistry determinations were reported: urea 14 mg. per 100 cc., sugar 75 mg. per 100 cc., chlorides 585 mg. per 100 cc. and proteins 6.2 gm. per 100 cc. and the carbon dioxide combining power 54 volumes per cent. The

Wassermann test was done twice and was reported "plus and minus." The Kahn test was 2 plus. The spinal fluid Wassermann and colloidal gold tests were negative. A Relbuss test meal was reported to show a free acid of 10 millimols and a combined acid of 24 millimols. Repeated stool examinations disclosed the constant presence of occult blood. The electrocardiogram was normal.

Gastrointestinal x-ray (Fig 130) disclosed a huge ulcerating lesion on the posterior wall of the lesser curvature aspect of the stomach just below the fundus. The stomach seemed to be displaced somewhat anteriorly. Whether the lesion



Fig 130 (Case X) —Preoperative x-ray. Note ulcer indicated by arrows and its proximity to region where esophagus enters the stomach (marked by "X").

was benign or malignant or whether the lesion was primarily an extrinsic mass in the region of the tail of the pancreas could not be determined.

Gastrosocopy was attempted, but it was impossible to visualize the lesser curvature of the stomach, just below the fundus.

An exploratory operation was done on May 6, 1946, under continuous spinal anesthesia, supplemented in course with ethylene. On the lesser curvature and posterior wall of the stomach, adjacent to the esophagus, was a huge ulceration, the crater of which measured 5.5 cm. There was no penetration into the pancreas. There were many enlarged nodes which were obviously inflammatory. After careful palpation and partial visualization, it was felt that the lesion was benign,

and accordingly a typical palliative gastrectomy was performed, the ulcer being left in situ. Gastrointestinal continuity was restored by an antecolic gastrojejunostomy of the Hofmeister type.

The resected specimen measured 5 cm. along the lesser curvature and 14 cm. along the greater curvature. The microscopic examination revealed chronic gastritis. No ulcer or tumor was found in the specimen.

Postoperatively the patient suffered from a gastric atony for about ten days during which time he suffered from upper abdominal pain which he stated was quite different from the pain he had had preoperatively. Following the resumption of gastric motility the patient improved rapidly. On the fifteenth postopera-



Fig. 131—The same patient fifteen days after partial palliative gastrectomy

tive day the stomach was examined roentgenographically (Fig. 131). The gastric ulcer was markedly diminished in size. On the nineteenth postoperative day gastroscopy was again performed, but the ulcerated area could not be visualized. The patient was discharged on the twentieth postoperative day.

The patient has been seen repeatedly in the Follow Up Clinic. He was last seen on October 16, 1946, at which time he had gained 10 pounds in weight. He looked and felt well. X-ray examination of the stomach was repeated on September 10, 1946 (Fig. 133). The ulceration previously seen could no longer be demonstrated. Reflux test meals were performed on September 9, 1946, and again on September 30, 1946; both tests showed complete absence of free hydrochloric acid, and the maximum combined acids measured 20 millimols.

It seems logical to assume that in selected cases of high lying chronic gastric ulcers, palliative gastrectomy produces a permanent gastric achlorhydria, with subsequent healing and disappearance of the ulcer which was left in situ. These patients remained clinically



Fig. 132 --The same patient four months after partial palliative gastrectomy. Note complete healing of ulcer.

free of symptoms and gastroscopic and x ray examinations have failed to reveal any recurrence of either a gastric or a gastrojejunal ulcer. This operation has its place in the surgery of peptic ulcer and is indicated in benign lesions limited to the upper third of the stomach.

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Fig. 131—The same patient fifteen days after partial palliative gastrectomy

tive day the stomach was examined roentgenographically (Fig. 131). The gastric ulcer was markedly diminished in size. On the nineteenth postoperative day gastroscopy was again performed but the ulcerated area could not be visualized. The patient was discharged on the twentieth postoperative day.

The patient has been seen repeatedly in the Follow Up Clinic. He was last seen on October 16, 1946 at which time he had gained 10 pounds in weight. He looked and felt well. X-ray examination of the stomach was repeated on September 10, 1946 (Fig. 132). The ulceration previously seen could no longer be demonstrated. Rehfuss test meals were performed on September 9, 1946 and again on September 30, 1946; both tests showed complete absence of free hydrochloric acid, and the maximum combined acids measured 20 millimols.

It seems logical to assume that in selected cases of high lying chronic gastric ulcers, palliative gastrectomy produces a permanent gastric achlorhydria, with subsequent healing and disappearance of the ulcer which was left in situ. These patients remained clinically



Fig 132—The same patient four months after partial palliative gastrectomy. Note complete healing of ulcer.

free of symptoms and gastroscopic and x ray examinations have failed to reveal any recurrence of either a gastric or a gastrojejunal ulcer. This operation has its place in the surgery of peptic ulcer and is indicated in benign lesions limited to the upper third of the stomach.

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BLEEDING AS A LATE SEQUEL OF SUBTOTAL GASTRECTOMY OF THE BILLROTH II TYPE FOR DUODENAL ULCER

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ALTHOUGH subtotal gastrectomy has been advocated as the procedure of choice in the surgical treatment of gastric and duodenal ulcer for over two decades, only in recent years has its radical approach been finding general favor with surgeons in this country. As a consequence of this delay in adoption of the operation, many clinics have not had sufficient opportunity to follow cases postoperatively over extended periods of time. Observations relating to the late effects of subtotal gastrectomy, therefore, are of particular interest and significance. For these reasons, this communication is being devoted to a consideration of the problem of "late bleeding," which in the experience at the Mount Sinai Hospital Gastric Clinic has been found to be an important late sequela of the use of subtotal gastrectomy of the Billroth II type for duodenal ulcer.

Subtotal gastrectomy has been employed as the operation of choice for peptic ulcer at the Mount Sinai Gastric Clinic since 1923. In brief, this long experience has revealed that, although radical resection is uniformly followed by excellent results when employed for gastric ulcer, such is not the case when it is used for duodenal ulcer. In a small but significant percentage of duodenal ulcer cases, subtotal gastrectomy results in failure particularly because of the recurrence of ulceration. Moreover, there appears to be a definite relationship between the influence of the operation on gastric acidity and the ultimate therapeutic result obtained. This Clinic has rarely, if ever, observed a peptic ulcer in the absence of free hydrochloric acid. Acidity studies have revealed that subtotal gastrectomy produces a true achlorhydria in 90 per cent of gastric ulcer patients and an apparent or neutralization achlorhydria in about 50 per cent of duodenal ulcer patients. In the remaining group of patients who disclose free acidity in the gastric contents, the failures of the operation are found. The end results of treatment¹ and their statistical significance² have been

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fully reported. Because "hemorrhage" has been such a prominent symptom in so many of the cases which we have encountered with recurrent complaints, we consider it a problem that merits attention. This study is based on a review of twenty three such cases of late bleeding.

Since this is a report based on the experience of a particular clinic, certain factors relevant to it must be appreciated. In the first place, it must be remembered that subtotal gastrectomy comprises the Billroth I and the Billroth II types of operation. This Clinic has employed the Billroth II method exclusively, so this discussion relates to a sequela of that type of procedure. Although there have been modifications in technic over the years,³ the procedure followed has been essentially the one developed and standardized by Dr. A. A. Berg⁴ of this Clinic. In substance, it comprises a liberal resection, which reaches from well above the re-entrant angle of the stomach proximally and extends beyond the pyloric ring distally to include a portion of fundus, the antrum, the pylorus and the ulcer-involved portion of duodenum whenever feasible, gastrointestinal continuity being restored by a partial terminal lateral anastomosis (Hofmeister method). Surgical treatment of chronic peptic ulcer at this Clinic has been restricted to those cases in which medical treatment has failed. The recognized indications for surgical intervention have been intractable pain, unrelieved obstruction and repeated hemorrhages. The Mount Sinai Gastric Clinic comprises a group activity of surgical, medical and research personnel devoted to the study and treatment of diseases of the stomach and duodenum, such as are encountered in the wards of that hospital. All cases are followed after operation at regular bi-monthly intervals in a special gastric follow-up. Observations are made through personal interviews and are appraised before a group of surgeons, gastroenterologists and members of the house staff, so that results reflect a combined rather than an individual evaluation.

Since 1923 456 patients with duodenal ulcer have been followed for a year or longer after undergoing subtotal gastrectomy (Billroth II). Twenty three patients (twenty one men and two women) are known to have had gross hemorrhages, i.e. either melena or hematemesis. The hemorrhages occurred at intervals varying from a few months to twelve years after operation. The fact that six patients bled for the first time five years or longer after operation emphasizes the importance of following such patients at regular intervals over extended periods of time, in order to determine the true end results of treatment. In seven cases the bleeding was severe enough to reduce

the hemoglobin below 30 per cent Of interest is the fact that twelve of the twenty-three patients had bled prior to operation, and eight had had several episodes of melena or hematemesis Five of these eight bled several times after operation On the basis of clinical features the twenty three patients may be further classified in two groups, those in whom hemorrhage was the sole symptom, and those in whom the bleeding was preceded, accompanied or followed by ulcer symptoms, especially pain

PAINLESS BLEEDING AFTER SUBTOTAL GASTRECTOMY

In fifteen patients bleeding was the sole symptom The hemorrhages occurred at various intervals, the longest being twelve years after operation In four patients the hemoglobin fell below 30 per cent Eight patients had had gross hemorrhages of a severe degree prior to subtotal gastrectomy, and in four there had been more than one episode Three of these four patients with multiple bleeding bled several times after operation All cases responded to conservative therapy, and only after bleeding had ceased were investigative procedures carried out Gastric analysis revealed free hydrochloric acid in appreciable amounts in the fifteen patients upon whom such studies were made The x ray examination was reported as negative in ten cases, but gastroscopic examination confirmed the presence of superficial anastomotic ulceration in three of these A jejunal ulcer was reported in three cases, and lesser curvature gastric defects were noted in two others

BLEEDING ASSOCIATED WITH PAIN FOLLOWING SUBTOTAL GASTRECTOMY

In eight cases the postoperative bleeding was associated with pain The hemorrhages occurred at intervals varying from a few months to three years after operation In four patients the bleeding was most severe, the hemoglobin falling below 30 per cent In four patients hemorrhage recurred promptly after the operation In every instance the x ray examination showed evidence of a penetrating jejunal or gastro jejunal ulcer A high concentration of free hydrochloric acid was found in the gastric contents in all cases These patients remained intractable to medical treatment Surgical exploration in four disclosed acute penetrating ulcers of the jejunum

The clinical, diagnostic and surgical findings in these cases indicate that late bleeding occurring after subtotal gastrectomy (Billroth II) is due usually to an ulceration in the jejunum, and only occasionally

to such a lesion in the stomach. The pathology is essentially similar to that in failures following the use of gastroenterostomy for gastroduodenal ulcer, in which late bleeding is frequently such a prominent symptom. This is understandable, when it is borne in mind that a Billroth II subtotal gastrectomy represents anastomosis of the jejunum to a partially resected stomach. The gastrojejunostomy plays no part in the rationale of radical resection but is utilized of necessity, because for most surgeons it is the only feasible means of restoring gastrointestinal continuity after a radical partial gastric resection. The pathology of the late bleeding after subtotal gastrectomy, therefore may logically be discussed in the light of our previously reported observations in cases of late bleeding after gastroenterostomy. In the past, this Clinic has frequently employed subtotal gastrectomy when duodenal ulcer has failed to respond to gastroenterostomy. The resected specimens have afforded unusual opportunity for direct observation of the pathology in such cases. In the study of eighty eight resected specimens reported in 1938 by Ginzburg and Mage,³ the following pertinent observations were made with regard to the pathology of late bleeding. In every case of hemorrhage associated with pain, the specimen revealed a deep penetrating jejunal or gastrojejunal ulcer which showed no tendency to heal. The depth and activity of the ulceration readily explain its easy detection by x ray and its resistance to conservative treatment. In contrast, the specimens in cases of "painless bleeding" uniformly disclosed superficial jejunal or anastomotic ulcerations which showed no tendency to penetrate into adjacent vessels. This pathology is what might be expected because it seems unlikely that the degree of penetration necessary to impinge upon a mesenteric vessel could occur without inducing pain. The superficial nature of the ulcerations in cases of "painless bleeding" and their tendency to rapid healing explain their ready response to conservative therapeutic measures. This fact also explains the frequency with which x ray investigation fails to reveal evidence of these superficial ulcerations. It is customary to perform x ray examinations in patients with gross hemorrhage only after acute symptoms subside usually after several weeks of medical treatment. Superficial ulcerations are apt to be either healed or almost healed after such a period of time.

In this discussion the terms "ulcer" and "ulceration" have been used interchangeably as descriptive of peptic ulcer in the pathologic sense. It is recognized that "erosions," gastritis or jejunitis," which may be ascribed to a factor other than an underlying peptic ulcer diath

sis, occasionally causes painless bleeding. We have observed cases where such findings could be attributed to dietary indiscretions, such as a gastrojejunitis resulting from excessive alcohol, or to a mechanical factor, such as the reaction resulting from a prolapse of a jejunal loop through the gastroenteric stoma. We have been careful to exclude such cases from this study. There is a well recognized point of view which considers erosions, gastritis, duodenitis and the like to be manifestations of peptic ulcer disease, particularly when they occur in an individual with a known ulcer diathesis. This aspect of the problem has been fully considered in a recent communication by Moschcowitz, Mage and Kugel.⁶ In a sense, it seems to be an academic question whether a severe hemorrhage occurring months or years after subtotal gastrectomy for a duodenal ulcer arises from an "ulcer" or from an "erosion." In the final analysis, the operation did not protect the patient against a serious complication of ulcer activity.

It will be noted that a majority of the patients who bled after subtotal gastrectomy had also bled prior to operation. Whereas this may suggest the possibility of a bleeding diathesis, there has been no evidence to prove such a contention. It seems far more likely that hemorrhages recurring in the same individual before or after subtotal gastrectomy for duodenal ulcer are merely the results of recurring ulcerations. For the same reasons we believe that the frequency of bleeding is merely fortuitous and is dependent upon the factors that determine the remission or recrudescence of peptic ulcer.

COMMENT

From this study it appears that bleeding after a subtotal gastrectomy for duodenal ulcer is usually due to a jejunal or anastomotic ulceration. When the bleeding is painless, the ulceration, as a rule, is superficial and tends to heal readily. For this reason these cases respond satisfactorily to conservative therapy. It has been seen that patients with "painless hemorrhage" may bleed severely. Although no patient died from bleeding in this series, it is recognized that such a possibility always exists with gross hemorrhage from a peptic ulcer. In the only death we have observed from late bleeding following gastroenterostomy for duodenal ulcer, autopsy disclosed an erosion in the jejunum as the source of the bleeding. Inasmuch as a fatal complication is so rare and surgery in recurrent ulceration after subtotal gastrectomy is so hazardous, we strongly believe that the "painless bleeding" in this group should always be treated conservatively. Pain and bleeding occurring after subtotal gastrectomy for duodenal

ulcer are usually due to an active penetrating jejunal or gastrojejunal ulceration. Such an occurrence presents a difficult and serious therapeutic problem, because it portends the existence of an underlying ulcer diathesis of sufficient intensity to nullify whatever potential benefit might be expected from further radical surgery. Although there is a natural tendency to question the adequacy of the extent of resection in any case of failure of subtotal gastrectomy, the fact remains that there are patients, of whom there were two in this series, who continue to secrete free hydrochloric acid despite repeated resections and a minimum of remaining stomach. In view of the doubtful therapeutic outlook and the extreme hazard involved in the surgery of secondary ulceration after subtotal gastrectomy, this Clinic until recently treated cases of "bleeding associated with pain" conservatively. However, there is a promise of some therapeutic help for these cases in the operation of "vagotomy," which was recently proposed for the surgical treatment of peptic ulcer. Theoretically, in the viewpoint of this Clinic at least, if there is a logical indication for the use of vagotomy, it is a recurrence of ulceration after subtotal gastrectomy. It is our present opinion that such recurrences develop because of the failure of the operation to control the secretion of free hydrochloric acid in the stomach. We know from physiologic studies that resection of the pylorus and antrum abolishes only the chemical phase of gastric secretion, and that when free hydrochloric acid persists after their removal it results from a stimulus which is conducted over the vagus pathway. Theoretically, section of the vagi should eliminate this persisting phase of gastric secretion, the so-called psychic phase. Vagotomy therefore, should create an achlorhydria which we regard to be the ideal state for the healing of a peptic ulceration and the prevention of its recurrence. For the past year this Clinic has employed the operation of "vagotomy" in the treatment of several cases of recurrent ulceration after subtotal gastrectomy. Although some of the immediate results have been gratifying, this experience is still too limited to permit any conclusions as to its value in the treatment of these intractable cases of bleeding associated with pain.

CONCLUSION

Bleeding, manifested by melena or hematemesis with or without pain, occurs sufficiently often after subtotal gastrectomy of the Billroth II type for duodenal ulcer to be recognized as a significant late sequela of that operation. When the bleeding is painless, it is usually due to superficial ulcerations or erosions in the jejunum or at the gastro-

enteric stoma, and as a rule responds to conservative treatment. If the bleeding is associated with pain, it is invariably due to an active penetrating ulcer. This type of case does not ordinarily respond to medical measures, and further radical surgery is contraindicated because of its great hazard and doubtful therapeutic outcome. The operation of vagotomy, on theoretical grounds, offers promise of particular benefit, but its ultimate evaluation requires further experience with its use.

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SUPRADIAPHRAGMATIC VAGOTOMY IN GASTROJEJUNAL ULCERATION FOLLOWING SUBTOTAL GASTRECTOMY FOR DUODENAL ULCER

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In a previous communication we presented our experiences with the operation of vagotomy in the therapy of gastrojejunal ulcer.¹ At that time we stated that it seemed most logical to divide the vagus nerve supply to the stomach and thereby eliminate the psychic phase of gastric secretion. We also stated that in our opinion the most accessible surgical approach for complete vagotomy was through the left chest. We therefore performed supradiaphragmatic bilateral vagotomy in two cases of gastrojejunal ulcer occurring after subtotal gastrectomy. One patient died of hemorrhage into the adrenal gland fourteen days after operation. Postmortem dissection of the vagi in that case revealed that 20 to 40 per cent of the vagus fibers about the esophagus were still intact despite our determined effort to divide the nerves completely at the time of operation. Division of the vagus nerves in the sec

been performed,

as proved by the

suffered an empyema and thirteen months later developed another gastrojejunal ulcer which required further surgery. Unfortunately, the unfavorable results in those two cases led us to discontinue supradiaphragmatic vagotomy at that time.

During the past year, however, there have been several reports in the literature on the beneficial effect of bilateral vagotomy in the therapy of peptic ulcer.^{2, 3, 4, 5} Excision of the nerve trunks overlying the esophagus from the root of the lung to the diaphragm was advocated. This technic apparently achieved complete division of the nerves to the stomach. The introduction of penicillin did much to prevent pleural infections. Finally, inasmuch as adrenal hemorrhages

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have not been reported, this accident in one of our cases was probably fortuitous and not the result of the vagotomy. We therefore renewed our studies, and within the past year have performed supradiaphragmatic bilateral vagotomy in a number of cases of duodenal and gastrojejunal ulcers.

In this presentation a preliminary report is made of the early effects of bilateral supradiaphragmatic vagotomy in ten cases of gastrojejunal ulcer in which a subtotal gastric resection had previously been performed for duodenal ulcer. This group of cases is of particular interest in that removal of the second phase of gastric secretion by subtotal gastrectomy failed to prevent further peptic ulceration. The benefits derived from gastric resection are said to stem from the excision of a large fraction of the acid secreting portion of the stomach from the removal of the pyloro antral mucosa, which produces a hormone that stimulates the acid secreting glands,⁶ and finally from the fact that a patulous gastroenteric stoma permits the reflux of neutralizing alkaline duodenal juices. If, therefore, the pylorus or a portion of the antrum is retained, or if the resection is inadequate in extent, then the desiderata of the operation may not be achieved. This may explain recurrences in two of our cases. In one, the pylorus had not been excised, and a prepyloric "auschaltung" had been performed. In the other, only a small section of stomach had been resected. On the other hand, in the remaining cases all the prerequisites of an ideal subtotal gastrectomy were fulfilled and yet gastrojejunal ulceration had occurred. Perhaps in these cases the emotional factors were so dominant that the psychic phase of gastric secretion played more of a role than the chemical phase in the causation of ulcer. If this supposition is correct, then cure should result from severance of the vagi and elimination of the psychic phase of gastric secretion. Actually, the immediate results have been most promising.

The technic of the operation is most simple. For anesthesia in supradiaphragmatic vagotomy, cyclopropane given by endotracheal technic is employed. The surgical approach is through an incision in the left eighth intercostal space from the angle of the ribs to the anterior axillary line. The ribs are spread and held apart by a self retaining rib spreader. The lung is retracted upward from the field after incision of the infrapulmonary ligament. A longitudinal incision is made in the mediastinal pleura over the lowest part of the esophagus, which is mobilized by blunt dissection. A Levin tube passed prior to operation helps identify the contracted esophagus. By palpation the vagus nerves are identified as they lie on the esophageal wall and are easily

isolated Traction on the nerves brings into evidence numerous inter-lacing branches which are severed as the nerve trunks are dissected and eviscerated from just below the root of the lung to their entrance into the substance of the diaphragm. The mediastinal pleura is closed with a few interrupted sutures. Penicillin (150 000 units) is instilled in the left thorax. The lung is inflated prior to closure to reduce postoperative pneumothorax to a minimum, and the chest wall is closed without drainage. Early ambulation is practiced, patients being allowed up on the first day after operation. Pleural fluid develops in about half the cases and requires aspiration in about 25 per cent. Test meals and x rays are performed twelve to fourteen days after operation, and again three to six months later. These records afford contrast study with similar preoperative tests.

SUMMARY OF CASES

Ten patients with gastrojejunal ulcer following subtotal gastric resection, which were recalcitrant to medical treatment were submitted to bilateral supradiaphragmatic vagotomy. Two cases which were completed seven years ago have been previously reported¹. In the remaining cases operation has been done within the past year. The patients include five men and three women. The gastrojejunal ulcers were present from four months to six years prior to vagotomy. The presenting symptom in nine of the ten cases was pain although two of these patients also had considerable gastrointestinal bleeding. The tenth patient suffered from massive hemorrhages resulting in a hemoglobin as low as 30 per cent on one occasion.

Favorable results have been noted in the eight cases done this year. Five patients have experienced no abdominal symptoms and three are much improved. Of these three only one has had symptoms at all resembling those of ulcer and she suffered only mild heart burn, whereas prior to operation she complained of severe pain and melena. In two of the cases the ulcer which was present just before operation could no longer be demonstrated by x rays taken within twelve to eighteen days after operation. A third case showed marked diminution within fourteen days in the size of the ulcer.

Five of the eight recent patients showed no acid response to insulin hypoglycemia, indicative of complete section of the vagal nerve supply to the stomach. Two had very definite acid response to this test, indicating that at least some residual gastric vagal innervation still remains. The third patient had a slight rise in acidity late in the curve which probably indicates that a partial rather than total, vagotomy

had been performed. We wish to emphasize again that the insulin hypoglycemia test is an excellent indicator of partial or complete vagotomy. If all the vagal fibers are severed the test will be negative, but if even a few vagal strands are still intact a positive test will result. The test must be controlled by blood sugar determinations; the insulin should be given intravenously, and the stomach must be proved capable of secreting acid when stimulated by other test substances. Night secretion studies were done in four cases of which three showed anaecidity and one considerable acid secretion. The total volume changes of the night secretion in the preoperative and postoperative tests were not significant.

COMMENT

Certainly no final conclusions can be drawn from cases followed so short a time, but there is one most impressive feature that must be emphasized. In most of the cases the pain was intense right up to the morning of operation. In several of the cases the preoperative fasting period of twelve hours was agonizing because milk, which usually relieved the pain, had to be denied. Following vagotomy the effect was dramatic. The abdominal pain was relieved immediately and has not returned during this limited period of observation.

It is also to be noted that the early results in those cases in which the vagus nerves were incompletely divided were as good as those in which complete vagotomy was accomplished. One patient in whom a definite acid response to insulin hypoglycemia had been obtained showed rapid ulcer healing as evidenced by x ray. Whether partial vagotomy will ultimately prove as effective as complete vagotomy remains to be seen. Theoretically this should not obtain as it has been shown experimentally in dogs that gastric pouches retaining only a fraction of their vagus innervation secrete acid in response to psychic stimuli as effectively as do pouches with practically complete vagal innervation.¹ In one case with a seven year follow up partial vagotomy afforded relief of pain for thirteen months before another gastrojejunal ulcer developed.

Bilateral vagotomy in the treatment of gastrojejunal ulcer after subtotal gastric resection appears to give satisfactory results. It is probable that it is successful because both the psychic and chemical phases of gastric secretion have been markedly reduced or negated. It may be possible that in the future in order to prevent the development of recurrent peptic ulcer the procedure of choice may be a subtotal gastrectomy combined with an infradiaphragmatic vagotomy.

This would allow an adequate exploration of the local lesion, eliminate the chemical as well as the psychic phase of gastric secretion, and incidentally prevent the distressing complication of gastric dilatation which in a sizable number of cases follows bilateral supradiaphragmatic vagotomy alone for duodenal ulcer. However, it must be borne in mind that the mobilization of the esophagus may add to the risk of an already formidable procedure and severance of all the vagus nerves by the infradiaphragmatic route may often prove difficult. At any rate, only careful follow-up studies will prove which is the best method for treatment of peptic ulcer, be it supradiaphragmatic vagotomy alone, infradiaphragmatic vagotomy with gastroenterostomy or subtotal gastrectomy, or subtotal gastrectomy as the sole procedure followed by supradiaphragmatic vagotomy if the gastrojejunal ulcer should develop.

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THE SIGNIFICANCE OF THE GASTRIC ACIDITY IN THE SURGICAL THERAPY OF PEPTIC ULCER

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THE ultimate cause of peptic ulcer is, as yet, unknown. Ulcer in our opinion is probably not a disease with a unitary etiology. However, the important etiologic agent in most of the cases seems to be a psychosomatic disturbance.¹ Whatever the ultimate cause of ulcer may be, the idea is generally accepted that the actual mechanism of ulcer production is the so called "acid pepsin" factor. The following facts attest strongly to the striking importance of the acid-pepsin factor in the mechanism, the location, and in the medical and surgical treatment of peptic ulcers.

Peptic ulcer occurs only in acid pepsin areas. It does not exist actively in the presence of an achlorhydria. Medical measures which best control the acidity throughout the twenty four hours of the day, such as the author's continuous intragastric drip therapy, are the most efficient in healing the lesion.^{2, 3} Recurrent jejunal ulcers are not seen after surgical procedures which are followed by achlorhydria such as subtotal gastrectomy with or without vagotomy.

Because of these considerations, the medical and surgical gastrointestinal group at The Mount Sinai Hospital has concerned itself largely with this "acid-pepsin" factor during the past twenty five years. We have carried out numerous clinical, physiologic, statistical and surgical studies in an attempt to elucidate this problem more fully. It is the purpose of this publication to summarize briefly these studies and to emphasize again the central importance of the acid-peptic factor in the problem of the therapy of peptic ulcer.

PREOPERATIVE ACIDITY STUDIES

In a series of earlier studies⁴ we had found that there is a striking difference in the preoperative gastric acidity in gastric and duodenal ulcer. While it is possible that gastric ulcer at the angle commences in a hyperchlorhydric, hypersecretory milieu, fractional test meal studies have demonstrated that the majority of the cases of chronic

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gastric ulcer exhibit a normal or a low free acidity. Occasionally there is a transient achlorhydria which is not present in subsequent tests or disappears after a short period of medical therapy.

We have been at a loss to explain this somewhat diminished acidity in gastric ulcer. It is probably the result of a gastritis which, located about the ulcer and in the adjacent secretory tissue, acts as an inhibitor to secretion. The gastritis may precede or follow the ulcer. Thus gastritis plus the retention of the acid depressant function of the normal duodenum and upper jejunum (due to enterogastrone) seems a sufficient explanation of the lowered acidity in gastric ulcer.

Duodenal ulcer on the other hand offers a strong contrast in this respect to gastric ulcer. Our earlier studies had revealed the remarkable fact that 80 per cent of our duodenal ulcers exhibited a marked "clinical" hyperchlorhydria and hypersecretion. The other 20 per cent was normal. Achlorhydria in duodenal ulcer has not been encountered.

What is the explanation of the marked increase in acidity in duodenal ulcer? As a result of numerous studies we think that it is permissible to conclude that the primary cephalic or nervous (vagal) phase of gastric secretion is greatly increased in duodenal ulcer and not in gastric ulcer. When we subject unoperated duodenal ulcer patients to sham feeding (the chewing of an orange) or to insulin hypoglycemia (15 units of insulin intravenously usually induces a blood sugar under 50 mg per 100 cc which is a powerful stimulus to the vagus nucleus) there is a very high acidity response. This is not the case in gastric ulcer at least in respect to sham feeding.

Add to this the probability that the presence of a duodenal ulcer disrupts the normal inhibitory mechanism (due to enterogastrone) of the duodenum and upper jejunum and the explanation of duodenal ulcer hyperchlorhydria seems clear. In fact it is much more easily understandable than is the hyposecretion in gastric ulcer.

We shall see that this difference is of fundamental importance in the problem of the surgical therapy of peptic ulcer.

POSTOPERATIVE STUDIES

Today leaving aside for the present a discussion of the operation of complete vagotomy it is generally conceded that the operation of choice for gastric and duodenal ulcer is subtotal gastrectomy with terminolateral gastrojejunostomy. It is a good operation since it removes the lesion and the associated antrum gastritis; it gives an optimum motor effect and it abolishes or lowers greatly the gastric acidity. The last of course is the *sine qua non* for the surgical cure of

ulcer. In an experience of twenty-three years, I have not seen a recurrent jejunal ulcer after a subtotal gastrectomy in which there was an absence of free hydrochloric acid postoperatively. Nor does it seem to matter whether this postoperative achlorhydria is due to neutralization or is a complete achlorhydria.

In our earlier studies, in fifty-seven cases of corporeal ulcer (gastric ulcer at the angle) in all but three cases there was a postoperative achlorhydria. In the three cases, there was merely a trace of free acid late after the test meal. A long follow-up of many of these cases has not brought to light a single recurrent jejunal ulcer. "No acid—no ulcer" has long been a dictum. We may paraphrase it by stating "no postoperative free acid—no recurrent ulcer." We may, therefore, safely conclude that subtotal gastrectomy seems to be a complete cure for gastric ulcer at the incisura angularis.

With reference to duodenal ulcer, the postoperative acidity, unfortunately, does not present such a bright picture. In our earlier studies we quickly found, to our dismay, that only 55 per cent of our duodenal ulcers revealed a postoperative achlorhydria. In the other 45 per cent, free acidity of varying degrees persisted.

In some recent studies which will be published elsewhere in detail, Drs. Albert Cornell, Franklin Hollander and I found that practically the same postoperative acidity figures held true in Dr. Ralph Colp's more recent series.

We found, for example, in one period, in eighteen of twenty cases (90 per cent) of gastric ulcers at the angle, achlorhydria was present. In the same period, thirty-two of fifty-two patients (59 per cent) with duodenal ulcers developed a postoperative achlorhydria. It is quite striking that these percentages practically agree with the earlier series, already cited. Colp and Druckerman also found that the Madlener-Floerken's palliative resection for ulcer high on the lesser curvature is followed by an achlorhydria without recurrences.⁵

In the duodenal ulcers with retained free acidity, a not inconsiderable number developed a recurrent jejunal ulcer. The percentage as given by Mage and Hollander was as high as "in the neighborhood of" 9 per cent.⁶ While this figure represents probably only one third of the incidence of jejunal ulcer seen after simple gastroenterostomy, it is, nevertheless, far too high when we consider the magnitude of the operation of subtotal gastrectomy.

It seemed to us that a careful study of the preoperative and postoperative acidity in these two groups of patients might prove rewarding in that we might find some technical method of abolishing the

free acidity after subtotal gastrectomy for duodenal ulcer. Our study revealed the following:

1 Gastric ulcer exhibits a low acidity preoperatively and postoperatively because of the presumable gastritis, duodenal inhibition, and low vagal tone.

2 Duodenal ulcer exhibits a high pre-operative acidity due to excessive vagal irritability and a lack of normal intestinal inhibition.

3 Persistent postoperative free acidity is found most often in the duodenal ulcer patients with a high preoperative acidity.

4 Recurrent jejunal ulcer occurs practically entirely in the group of duodenal ulcers with a very high preoperative acidity.¹

5 The postoperative free acidity in duodenal ulcer is completely abolished by atropine sulfate.

6 The addition of vagotomy to subtotal gastrectomy abolishes the postoperative acidity in the majority of the cases.^{1, 2}

Comment.—It seems apparent that the future attack in the problem of surgical therapy of peptic ulcer should include a careful consideration of the role of the vagus nerves.

Supradiaphragmatic bilateral vagotomy alone does not seem to be the answer. Time, experimentation and experience will probably lead us to a combination of subtotal gastrectomy (or even gastroenterotomy) with subdiaphragmatic vagotomy as the operation of choice for duodenal ulcer.^{2, 3} However, supradiaphragmatic vagotomy may be of value in the therapy of recurrent jejunal ulcers.

MISCELLANEOUS OBSERVATIONS

Night Secretion.—In over 200 studies of the night secretion in ulcer patients, as contrasted with normals, we have found a hyperchlorhydria and hypersecretion.¹⁰ This observation has been amply confirmed by Henning, Valdez and Dragstedt. We reject Sandweiss' conclusions¹¹ that the night secretion in ulcer patients is no higher than in normals since (1) he used mild ambulatory cases, (2) he aspirated the stomach completely all night, thus interfering with the duodenal regulatory (inhibitory) mechanism, and (3) his test meal was too heavy and too stimulating (containing meat soup, 200 cc of orange juice, and coffee). It is of interest to note that we found in the patients with subtotal gastrectomy with postoperative achlorhydria that they did not secrete free acid during the night.

The Nature of the Postoperative Achlorhydrias.—If one tests the achlorhydrias after a subtotal gastrectomy for gastric ulcer with neutral red and histamine, one finds a failure of the dye's appearance

and no free acid. This apparently implies a complete achlorhydria. Since the fundic secretory tissue with its vagal supply is intact, there must be an inhibition of the secretory cell itself. In the light of our present knowledge, the most logical explanation is a gastritis, whether due to preoperative or postoperative causes. Most of the achlorhydrias following operation for duodenal ulcer, however, show a neutral red secretion and free acid with the above test. This is therefore a neutralization achlorhydria. Nevertheless, it is a striking fact that it seems sufficient, in our experience, to prevent recurrent ulcers.

SUMMARY AND CONCLUSIONS

- 1 Peptic ulcer is probably a psychosomatic disease
- 2 The immediate mechanism is the acid pepsin factor
- 3 The acidity in gastric ulcer at the angle is usually normal or low
- 4 The acidity in duodenal ulcer is high in the majority of duodenal ulcer patients
- 5 The low acidity in gastric ulcer is probably due to gastritis and duodenal inhibition
- 6 The high acidity in duodenal ulcer is due to the vagus nerves and interference with the duodenal regulatory mechanism
- 7 Subtotal gastrectomy is today the operation of choice for both gastric and duodenal ulcer
- 8 After subtotal gastrectomy for "angle" gastric ulcer there is practically 100 per cent postoperative achlorhydria. After the palliative operation for high lesser curvature gastric ulcer there is also an achlorhydria without recurrences
- 9 No recurrences are seen in the presence of this achlorhydria
- 10 After subtotal gastrectomy for duodenal ulcer, achlorhydria occurs only in 55 per cent of cases
- 11 Recurrences are frequent (9 per cent) after subtotal gastrectomy for duodenal ulcer with retained free acidity
- 12 This retained acidity is probably due to the vagus nerves
- 13 Subtotal gastrectomy (or even gastroenterostomy) combined with subdiaphragmatic vagotomy seems to be indicated in the future surgical therapy of duodenal ulcer
- 14 There is a marked nocturnal hypersecretion in peptic ulcer patients
- 15 After subtotal gastrectomy, if there is an achlorhydria, the nocturnal acid secretion is also absent
- 16 While the postoperative achlorhydria is a complete one in

gastric ulcer and a neutralization one in duodenal ulcer either one is sufficient to prevent recurrent ulcer

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ANESTHESIA FOR GASTRIC SURGERY

MORRIS BIEN, M.D.*

The anesthesia of choice in gastric surgery is spinal for gastric or duodenal ulcer and general anesthesia for carcinoma. The ulcer patient is usually a good surgical risk in the 20 to 40 age group with relatively few concomitant lesions of the heart or lungs whereas more complications are found in the carcinoma group such as debilitation, inanition, old age and arteriosclerosis which favor the use of a general anesthesia. Specifically these factors, the age and physical state of the patient determine the type of anesthesia to be employed.

In addition to the choice of anesthesia, other responsibilities of the anesthesiologist include preoperative medication, administration of the anesthetic, supportive therapy during and immediately after the operation and the treatment of postoperative complications attributable to the anesthesia.

PREMEDICATION

Many patients express more fear of the anesthesia than of the surgery. The recognition of this situation has led the medical profession to employ both psychotherapy and drugs to overcome this fear. One of the greatest advances in anesthesia has been the recognition of the need for both psychic and physical sedation for persons coming to operation. It is therefore of the greatest importance that the patient be visited by the anesthesiologist on the day preceding the operation. The benefits derived are manifold. In the first place the patient is given an opportunity to express his fears and misgivings to a disinterested but sympathetic listener. Then the anesthesiologist can allay the patient's fears and bolster his confidence in the surgeon and the surgical procedure involved.

The extremely apprehensive patient is usually put to sleep in his room before the operation with basal anesthesia—either avertin rectally or intravenous sodium pentothal. This usually leads to a total amnesia for the interval beginning with the administration of the basal anesthesia and extending for several hours after the operation.

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interspace The tap is then performed using a 20 gauge Luer needle Then a solution, containing 20 mg of 1 per cent pontocaine and 2 cc of 10 per cent dextrose is attached to the hub of the needle One cubic centimeter of spinal fluid is then withdrawn, making a quantity of 5 cc This is then rapidly injected The needle then is withdrawn The rest of the novocaine-ephedrine mixture is given The patient is placed very carefully on his back and the table is tilted to a 3 to 5 degree Trendelenburg position The solution usually reaches the level of the second to fourth thoracic segment in less than one minute A 2.5 per cent pentothal solution is injected into the tubing Enough is used so that the patient is asleep throughout the operation, the average dose being about 15 cc Blood is given routinely during the operation to all patients undergoing gastrectomy The Levin tube is under the constant surveillance of the anesthetist It is his duty to aspirate the contents of the stomach and to observe, when the de Petz clamp is applied to the stomach, that the tube is pulled up and not engaged If there is any difficulty in respiration, oxygen is administered

Curare in small doses is used to supplement a spinal anesthesia which is wearing off, in preference to deep inhalation anesthesia

For inhalation anesthesia, our method of choice is the sequence of cyclopropane and curare, with an endotracheal tube in place We intubate our patients before the operation is started, because we are thus better prepared to handle the respiratory depression which may occur after the curare has been administered

This inhalation technique is also employed for transthoracic total gastrectomy and vagotomy operations

Where a palliative procedure for the very feeble is contemplated (gastrostomy, gastroenterostomy or jejunostomy), a field block is used to excellent advantage

POSTOPERATIVE CARE

The patient who has received spinal anesthesia is by far the easier to handle Our routine orders for such patients are (1) Keep the patient flat on his back until he can move his legs, then move him from side to side, (2) give an opiate every four hours for pain, (3) encourage deep breathing, (4) catheterize every eight to ten hours, if necessary, (5) see that the Levin tube is kept draining, (6) give nothing by mouth (Chemotherapy is instituted under the direction of the surgeon)

The postoperative orders for those who have had general anesthesia are the same with this exception They do not have to remain

We use hypnotics, the barbiturates, the night before to insure a good night's sleep. Two hours before the operative procedure, $1\frac{1}{2}$ grains (0.1 gm) of a short acting barbiturate is administered. In a great many instances, however, in which we anticipate difficulty in swallowing we have administered the barbiturate rectally. One hour before the operation morphine and scopolamine in the ratio of 1:25 are administered by hypodermic. The average doses are $\frac{1}{8}$ to $\frac{1}{4}$ grain of morphine and $\frac{1}{200}$ to $\frac{1}{100}$ grain of scopolamine. The barbiturate is omitted when a general anesthesia is contemplated. An infusion is always started in the patient's room on the left arm, and preferably with a No. 18 needle in place. The patient's stomach is washed out on the morning of operation and the Levin tube is left in place. A pint of blood is usually in the operating room and ready for immediate use.

CHOICE AND ADMINISTRATION OF ANESTHESIA

The choice of anesthesia is dependent upon (1) the age and physical state of the patient, (2) the type and site of the disease, (3) the extent of the surgical procedure, (4) the surgeon, and (5) the anesthetist. The surgeon is included as a human element in considering the choice of anesthesia because some surgeons do prefer one type of anesthetic to another. This preference is usually based on prejudice rather than scientific fact. The surgeon witnesses an anesthetic accident and thereafter condemns the anesthetic itself instead of analyzing all the factors which contributed to the accident.

The anesthesiologist may also be included as a human element in the choice of anesthesia. He may be more skillful in the use of one type of anesthetic procedure than another and this may influence his choice.

We use spinal anesthesia together with a light supplementary anesthesia for most of our patients with ulcer. Spinal anesthesia where indicated and in the hands of a competent anesthetist, insures maximum relaxation of the abdominal muscles. The agent most frequently used is pontocaine in combination with 10 per cent dextrose. Since the average time for a subtotal gastrectomy for ulcer is approximately fifty to fifty-five minutes with the extremes between thirty minutes and ninety minutes, it has not been necessary for us to use continuous or fractional spinal anesthesia.

The technic employed is as follows. With the patient in the lateral recumbent position, a skin wheal is raised with a mixture containing 1 per cent procaine and ephedrine (50 mg) at the second lumbar

ARE GASTRIC ULCER AND DUODENAL ULCER DIFFERENT DISEASES?

FRANKLIN HOLLANDER, PH.D.*

It is frequently said by clinicians that uncomplicated gastric ulcer and duodenal ulcer are "different diseases," even though they are manifestations of the same process, i.e., peptic ulceration. Since peptic ulceration arises from a disturbance in physiology, one might expect to find a physiological explanation for the clinical differences in these diseases. However, such physiological dissimilarities may reflect a difference in etiology, related to the predisposing factors, or they may be consequences of the locations of the lesions. It is my purpose here, first, to analyze the clinical differences between gastric and duodenal ulcer patients, and then to discuss two physiological mechanisms to account for them.

CLINICAL DIFFERENCES BETWEEN GASTRIC AND DUODENAL ULCER

It must be emphasized at the outset that all the differences under discussion are statistical in character—that is, they exist "on the average"—and that clear-cut variations between groups, without overlapping, do not exist. To take a simple illustration, it has been reported that duodenal ulcer occurs in patients of higher age than does gastric ulcer. This usually means that the *average ages* of two comparable groups of cases are unequal. Nevertheless, the *ranges* of these two sets of data are essentially identical, for both types of ulcer may occur at almost any age.

The factors which differentiate gastric and duodenal ulcer patients are as follows:

1. *Quantity of Gastric Juice*—The volume of secretion, collected during a fixed time-interval, is generally higher in duodenal than in gastric ulcer. Bockus,³ Vanzant and associates,¹⁵ and Ihre⁷ generally support this statement, the latter found that patients with gastric ulcer "showed a normal rate of secretion, while in most of those with duodenal ulcer there was a more or less marked hypersecretion." Ihre's evidence is based on a single aspiration, sixty minutes after injection of histamine or insulin. Reports based on fasting contents,²

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flat in bed for any prescribed time. If it was necessary to use curare at the latter stage of the operation, prostigmine 1:1000 to 1:2000 is given intravenously before the patient leaves the operating room.

SUMMARY

The duties of the anesthesiologist in the management of anesthesia for surgical procedures on the stomach have been outlined. Preoperatively, his primary interest is to act as the liaison man between the patient, the surgeon and the hospital. The need and amount of premedication has been outlined. The importance of psychic and physical sedation has been established. The choice of agents and methods has been summarized. Supportive measures enhancing anesthesia have been mentioned. Postoperative care has been reviewed.

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for duodenal ulcer continues to rise to the end of the two-hour period of observation. The initial drop in both curves is ascribed to dilution of gastric contents by the test meal. The subsequent rise reflects the increasing rate of secretion, stimulated by the neural and chemical phases of the secretory process. During the second hour, secretory activity is partially inhibited in the normal individual and the gastric ulcer patient but in most of the cases of duodenal ulcer such inhibition is deficient and the curve continues to rise to an acidity considerably greater than the maximum in the gastric cases.

3 *Motor Factors: Tonicity, Peristalsis, and Pyloric Control*—An ulcer in the duodenum is usually accompanied by hyperactivity of these neuromuscular mechanisms,^{3, 11} but a lesion in the stomach is less likely to manifest such abnormalities. A juxta-pyloric lesion, on the antral side, frequently resembles a duodenal ulcer in this respect, and for this reason the former is frequently classified as duodenal, rather than gastric. Such hypertonicity and hyperperistalsis also reflect underlying physiological disturbances and therefore they also require explanation. On the contrary, certain other concomitants of ulceration (i.e. spastic manifestations at the incisura, hour glass contractions, nausea, regurgitation into the esophagus and vomiting of food) are usually considered to be reactions of the gastric musculature, either directly to the irritative action of the lesion and its attendant gastritis, or indirectly via a local reflex.

4. *Size of the Ulcer*—A statistical study by Alvarez and MacCarthy¹ on 638 gastric ulcers and 425 duodenal ulcers, excised at operation, revealed a striking difference in size of the lesion. The average diameters were 28.5 and 5.5 mm. respectively. Over 21 per cent of the gastric lesions had diameters greater than 18 mm., and some were as wide as 40 mm. One might expect the reverse to be the case, since the duodenal mucosa is generally more responsive than the gastric mucosa to irritation by gastric secretion, also, because in cases of duodenal ulcer there is a tendency toward a higher output of pepsin and acid. Actually, the digestive action of the gastric juice is less powerful within the duodenal cap than in the gastric cavity, because of the extensive neutralization of gastric chyme by the secretions within the duodenum. Hence, gastric juice which is only mildly potent may give rise to a lesion of good size in the stomach, but juice of greater acidity may induce a smaller lesion in the duodenum where its potency is considerably diminished. Therefore difference in ulcer size is a secondary phenomenon, rather than one dependent on essential physiological differences.

fractional gastric analysis after a test meal,² and continuous aspiration during the night to study the interdigestive phase of secretion^{5, 6, 10, 11} are all consistent with this generalization. In regard to night secretion, however, the results of Sandweiss and his co-workers⁹ present an interesting contradiction caused by varying the collection technique, but since this can be explained in terms of the secretion inhibiting mechanism described below, it may be neglected here.

2 *Acid and Pepsin Concentrations of the Gastric Juice*—Studies on free acidity and pepsin activity of gastric aspirates yield results which conform closely with those for volume of secretion, independently of the test procedure.^{10, 12, 14} For both types of lesion, the data are scattered over wide ranges, but the range for gastric ulcer coincides with that for normal individuals, whereas for duodenal ulcer it reaches a distinctly higher limit. Correspondingly, the average also is greater in duodenal ulcer patients.

Curiously, certain results of Vanzant and her associates¹³ suggest that the acidity in cases of gastric ulcer may be slightly less than in patients without gastric disease, also, that patients with gastric ulcers smaller than 5 mm in diameter are prone to have a higher acidity than those with larger lesions. In the case of duodenal ulcers these relations are reversed: not only is the average acidity higher than in normal subjects, but small (or single) lesions are associated with lower acidities than large (or multiple) ones. The explanation for this is easily perceived. Both gastric and duodenal ulcers are surrounded by an area of inflammation. Gastritis may inactivate the parietal cells in part of the stomach, thus reducing the amount of hydrochloric acid formed during a gastric analysis. Duodenitis does not have this effect; on the contrary, it tends to inactivate an *acid inhibiting mechanism* initiated in the duodenum and thus permits the formation of even more hydrochloric acid than normally. Likewise a larger lesion tends to induce a larger area of inflammation irrespective of the site, so that in both cases the greater the ulcer the greater will be the effect—an increase with respect to the normal acidity in one case, and a decrease in the other.

There is one other respect in which the gastric acidity manifests an important difference between gastric and duodenal ulcer cases: i.e., the shape of the acidity curve during a two-hour fractional analysis. Using a test meal of zweiback and water Shay and associates¹² found that the first fifteen minute specimen is less acid than the fasting specimen, in both conditions, and for the next three specimens both curves rise. Thereafter, the curve for gastric ulcer falls off, but that

process, these mechanisms begin to reduce the output of gastric juice and the frequency of gastric emptying. They are initiated chiefly in the cap but also in the rest of the duodenum. These inhibitory mechanisms may be stimulated by various agents in contact with the duodenal mucosa: hypertonic solutions of salt, bicarbonate of soda, and glucose, fats and fatty acids, but particularly hydrochloric acid and acid gastric juice. It is significant that a hypotonic or isotonic solution of sodium bicarbonate exerts an opposite effect, because of its neutralizing action. The normal stomach responds to ingestion by pouring out its secretions, and later by increased peristalsis, tonicity, and intermittent opening of the pylorus. As gastric digestion progresses, however, the need for these activities diminishes. Hence, as the chyme enters the duodenum and impinges on its mucosa, it sets up a train of inhibitory reactions designed to reduce activity in the stomach. Finally, with complete evacuation of the uppermost portion of the digestive tract, the stimuli to these activities disappear, and with them the duodenal inhibiting mechanism. Evidence now available suggests that the inhibitory process is a dual one—(1) humoral, involving enterogastrone, and (2) neural—but its complete understanding is still lacking. Even the gastric emptying mechanisms are subject to debate. Shoy feels that the pyloric sphincter is the major agent of control, whereas Thomas¹² and Quigley³ emphasize antral motility. However, even if there are two inhibitory mechanisms they are initiated by the same stimuli under the same conditions. Concerning hydrochloric acid as one of these, there appears to be a critical pH threshold above which the inhibitory mechanisms are inactive but below which they come into full play. The existence of such a threshold has been established in dogs by Thomas and his associates.

Now how do these phenomena explain the differences between gastric and duodenal ulcers clinically? According to the mechanism of the duodenal ulcer, patients with gastric ulcer do not show this disturbance. This disturbance consists of a lowering of the pH threshold which is probably reversible, for "when the healing of the ulcer occurs, the response of this mechanism may, and often does, become normal." Such a lowering implies a decrease of inhibitory activity, and therefore, an abnormally prolonged output of acid and pepsin in the stomach. Gastric emptying is speeded up, because tonicity, peristaltic activity, and pyloric opening are maintained at an elevated level. Disturbance of these regulatory functions

5 Intensity of Pain—The greater pain suffered by the patient with duodenal (or pyloric) ulcer, as compared with the one with gastric ulcer, is another common difference between the two. Ulcer pain usually results from hypersecretion or hypertonicity in the stomach, and it has already been seen that such hyperactivity is more frequent and of longer duration in duodenal than in gastric ulcer cases. Hence, as with the size of the lesion, difference in pain intensity should also be considered a secondary phenomenon.

6 Sex and Age—The total incidence of peptic ulcer shows a significant sex difference—the ratio for males to females is about 4:1^{3, 4}—but a breakdown of the data shows that this same sex ratio holds for both gastric and duodenal types. The age factor, however, does differ somewhat. Peptic ulcer may occur at almost any age, but its incidence is greater during middle life. For duodenal ulcer, Eusterman and Balfour found that the peak of the incidence curve came in the fourth decade but for gastric ulcer it fell in the fifth. The corresponding averages also showed a difference of almost ten years, being 33 and 41 years respectively. As yet no explanation for this difference has been advanced.

PHYSIOLOGICAL MECHANISMS THAT MIGHT ACCOUNT FOR THESE DIFFERENCES

Let us now consider the two theories which have been proposed to account for the foregoing differences.

The Neural Theory—It is widely accepted today that a predominant factor in the etiology of peptic ulcer is a psychosomatic one. Although not always recognized this may be mediated by the sympathetic nervous system as well as the parasympathetic. It has been suggested therefore that such psychic disturbances occur more commonly in patients with duodenal ulcer than in those with gastric ulcer.^{3, 18} Direct evidence for this is lacking but Bockus cites Robinson as believing that 95 per cent of the duodenal ulcers may be characterized as "psychogenic ulcer." According to this view the gastric hyperactivity in the cases of duodenal ulcer is caused by the physiological disturbance arising in the brain. Since neither statistical nor physiological evidence has as yet been adduced to support these ideas, their validity is open to question.

The Duodenal Theory—This theory propounded by Shay and his associates,^{11, 12} is based on the existence in the normal duodenum of one or two inhibitory mechanisms for the control of motor and secretory activity in the stomach. At a certain stage in the direction

process, these mechanisms begin to reduce the output of gastric juice and the frequency of gastric emptying. They are initiated chiefly in the cap, but also in the rest of the duodenum. These inhibitory mechanisms may be stimulated by various agents in contact with the duodenal mucosa: hypertonic solutions of salt, bicarbonate of soda, and glucose, fats and fatty acids, but particularly hydrochloric acid and acid gastric juice. It is significant that a hypotonic or isotonic solution of sodium bicarbonate exerts an opposite effect, because of its neutralizing action. The normal stomach responds to ingestion by pouring out its secretions, and later by increased peristalsis, tonicity, and intermittent opening of the pylorus. As gastric digestion progresses, however, the need for these activities diminishes. Hence, as the chyme enters the duodenum and impinges on its mucosa, it sets up a train of inhibitory reactions designed to reduce activity in the stomach. Finally, with complete evacuation of the uppermost portion of the digestive tract, the stimuli to these activities disappear, and with them the duodenal inhibiting mechanism. Evidence now available suggests that the inhibitory process is a dual one—(1) *humoral, involving enterogastrone*, and (2) *neural—but its complete understanding is still lacking*. Even the gastric emptying mechanisms are subject to debate; Shay feels that the pyloric sphincter is the major agent of control, whereas Thomas¹⁵ and Quigley⁸ emphasize antral motility. However, even if there are two inhibitory mechanisms, they are initiated by the same stimuli under the same conditions. Concerning hydrochloric acid as one of these, there appears to be a critical pH threshold above which the inhibitory mechanisms are inactive, but below which they come into full play. The existence of such a threshold has been established in dogs by Thomas and his associates.

Now, how do these phenomena explain the differences between gastric and duodenal ulcer patients encountered clinically? According to Shay's clinical studies, most patients with duodenal ulcer show a considerable disturbance in these inhibitory mechanisms, whereas patients with gastric ulcer do not. This disturbance consists of a lowering of the pH threshold which is probably reversible, for "when the healing of the ulcer occurs, the response of this mechanism may, and often does, become normal." Such a lowering implies a decrease of inhibitory activity, and therefore, an abnormally prolonged output of acid and pepsin in the stomach. Gastric emptying is speeded up, because tonicity, peristaltic activity, and pyloric opening are maintained at an elevated level. Disturbance of these regulatory functions

is a direct consequence of the duodenitis associated with an ulcer in this region. A lesion in the stomach may be accompanied by a gastritis, but not, ordinarily, by an inflammatory process in the upper small bowel. Consequently, it is only in the presence of a duodenal ulcer that the duodenal mechanisms for control of gastric function suffer impairment. A duodenal pH resulting from a normal gastric acidity is effective in a person without a duodenal ulcer, but in the presence of a duodenitis the duodenal pH must become lower than this for the mechanism to be activated. In the latter situation, gastric secretion continues until the acidity in the duodenum is high enough to set off the impaired mechanism. Whether the patient with duodenal ulcer suffers a depression of this threshold, or a complete elimination of the control mechanism, is not yet clear from the evidence. Although Shay instilled pure hydrochloric acid of sufficiently high concentration and volume directly into the duodenum of such patients, he was unable to produce an appreciable effect in the gastric secretory response.

Shay's theory accounts very satisfactorily for the dissimilarities in secretory and motor response in duodenal and gastric ulcer patients, and it has more evidence to support it than the neural theory. It must be emphasized, however, that these physiological differences are a consequence of the location of the lesion, rather than a cause of it. Hence, we are hardly justified in advancing this physiological disturbance to support the contention that "gastric and duodenal ulcer are different diseases." In fact, it may be asserted that there is no conclusive evidence to support such a contention. Rather, the different clinical manifestations of these two types of ulcer must be considered to be results of the location of the lesions. Why one patient should develop an ulcer in the stomach and another in the duodenum will be clarified only by further research on the etiology of peptic ulcer.

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THE ROENTGEN DIFFERENTIATION OF BENIGN AND MALIGNANT ULCERS

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JOAN J. LIPSAY, M.D.†

UNEQUIVOCAL differentiation of benign and malignant ulcer of the stomach cannot be made roentgenologically. This can be achieved only by histological examination of all of the tissue about the ulcer or somewhat less surely, by observation of the course of the disease. However, it is possible in a large majority of cases to arrive at a diagnosis which is reasonably certain, or at a conclusion which indicates the proper therapy. Because roentgen diagnosis is not infallible even when based on characteristic findings, the need for additional data—both clinical and laboratory, and particularly that obtained by esophagoscopy or gastroscopy, is clearly imperative. It should be just as obvious that since the roentgen examination is the least distressing to the patient and, in general, is the most informative of any test outside of the clinical examination, it should be the initial test and universally applied.

BASIC PATTERNS

Simple Benign Ulcer.—The typical benign noncalloused ulcer appears as a smooth rounded projection from the gastric contour when the patient is turned so as to bring it into profile. The adjacent gastric wall is not indurated so that, roentgenologically, there is no rigidity nor loss of flexibility. The entire niche is outside of the gastric lumen and the wall adjacent to the niche is at the same level as the rest of the gastric outline. Peristalsis is not significantly altered except at the niche, which may move as a whole with the peristaltic waves. The surrounding mucosal folds are not significantly altered in width, distinctness or flexibility but they may radiate toward the niche. As the ulcer heals, the round projection becomes conelike or spiculated and finally disappears leaving a slight irregularity in the contour but the radiation of folds may become more pronounced.

Malignant Ulcer.—Carcinoma of the stomach has been classified (Borrmann) into (1) Polypoid tumor with an overhanging edge, its

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surface nodular and rarely ulcerated. (2) Ulcer surrounded by an elevated wall which is sharply demarcated from the surrounding mucosa. (3) Ulcer with a wall which is likely to be present only on one side of the ulcer. There is diffuse and progressive infiltration into the neighboring mucosa, the folds appearing stiff, broad and prominent.



Fig. 133—Benign ulcer. The base of the niche is somewhat irregular. The adjacent mucosal folds are thickened and less flexible than normal. The gastric contour above and below the niche is smooth and flexible.

ment. There may be nodular defects. (4) Diffuse infiltration. If an ulcer is present, there is no wall.

The malignant ulcer represents in most cases an eroded neoplasm, although transformation of a benign ulcer is claimed to be not infrequent by some authors. The niche, therefore, is usually only part of an infiltrating process which involves the stomach beyond the crater.

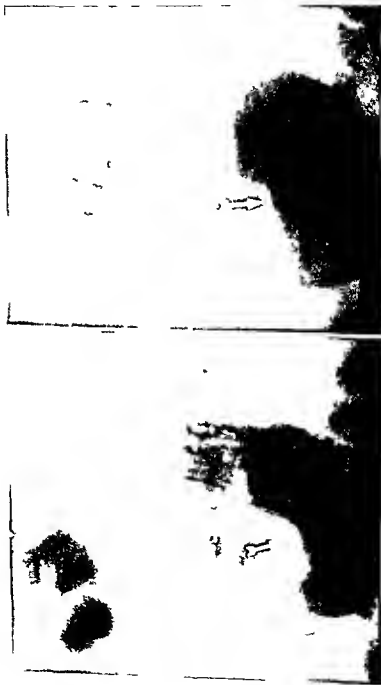


Fig 134—Small gastric neoplasm. The basic pattern of a rigid indented segment which is unchanged in its appearance during the various phases of the examination

margin. Less commonly, the niche represents practically the entire lesion and in this case it is likely to be large, triangular and irregular in outline. The basic roentgen pattern, therefore, is that of the neoplastic infiltration—namely, stiffness or rigidity with loss of flexibility. The involved segment is indented or depressed into the gastric contour, an appearance described by Bockus as a subtraction defect. The



Fig. 135—Malignant ulcer (white arrow). Wide and shallow. The base is irregular. The niche arises within the normal gastric contour and the adjacent contours (black arrows) are stiff and indented.

niche is often wide but shallow and the bulk of the crater is apt to be within the gastric outline. The base may be smooth and straight or on the other hand, it may be deep and irregular in outline even when the lesion is small. Irregularity in outline is mildly suggestive but not pathognomonic of neoplasm. There is a definite sloping wall on at least one side of the niche which intrudes into the lumen of the stomach like a ledge. Ordinarily the depression into the lumen along

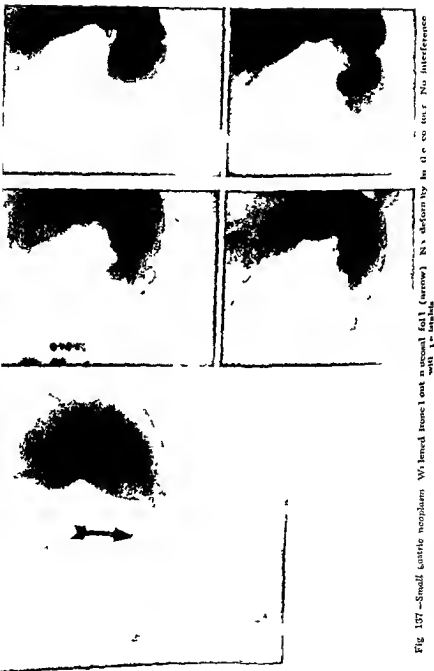
side the niche is more marked on the antral than on the cardiac side. The adjacent mucosa is likely to be altered the folds being stiff and lacking flexibility and regularity. They may be widened and indistinct, giving the impression of being ironed out. This change may end abruptly at the junction of tumor and normal mucosa but in other



r niche.
(to the

black arrow)

cases even apparently normal folds are reoriented. At the junction of the niche with the infiltrated segment there may be a semilunar defect the so-called meniscus sign due to an overhanging edge, or there may be small or large nodular filling defects. In most cases peristalsis halts at the zone of infiltration and continues beyond it although in rare instances a small carcinoma may not produce a con





138—Malignant ulcer (white arrow) Extent of entire infiltration indicated by black arrows Mucosal folds are markedly disoriented widened and disoriented

stantly rigid segment. In other instances, the niche may ride with the peristaltic wave and its lack of participation in peristalsis might not be recognized fluoroscopically.



Fig 139—*Malignant ulcer* Meniscus sign (white arrows) due to irregular overhanging edge

Complicated Benign Ulcer.—While simple benign ulcer presents a characteristic roentgen appearance, there are many modifying conditions. The benign niche may be irregular in outline as the result of healing or the deposition of food, mucus, granulation tissue or blood



Fig 140—Benign perforating ulcer. Radiating mucosal folds shown on pressure. The overhanging edge is due to inflammatory edema.

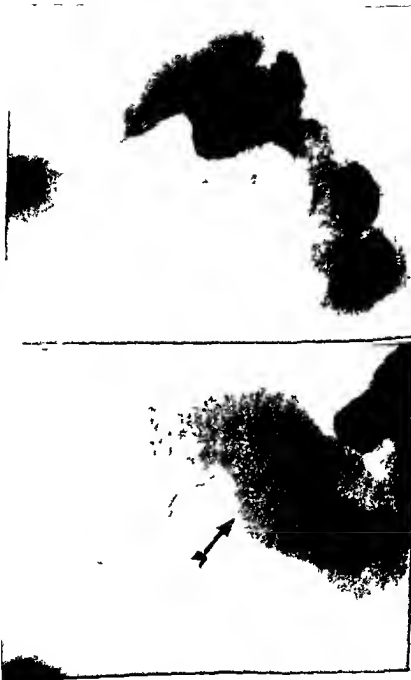


Fig 141A—Perforating benign ulcer (white arrow). Irregular base. Right wall distal to ulcer (black arrow). January 1943—left. August 1943—right.

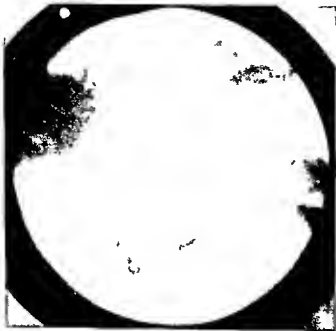


Fig 141B—February

luration of the gastric folds which radiate toward the niche

clot. A large shallow benign ulcer with a thick calloused wall and induration of the adjacent gastric segment may provide precisely the same roentgen appearance as a malignant ulcer. Inflammatory edema may produce localized or extensive swelling of the mucosal folds which may become nodular or ironed out and lose their flexibility. As an additional difficulty in diagnosis, it is recalled that these inflammatory changes may occur around carcinoma. Chronic hypertrophic gastritis, which may completely hide the niche, modifies the appearance of the surrounding mucosa due to stiffness and widening of the folds. On the other hand, radiation of folds towards the niche is more often a benign finding. Deformity of the contour may result from the organic lesion itself, from retraction due to the ulcer or as a secondary functional change. An especially difficult group of cases are those which present a spastic antral deformity secondary to a remote ulcer of the lesser curvature.

There are certain types of benign ulcer which may present special features. The accessory pocket of a perforated ulcer is readily recognized by the surrounding air cap in the erect position. The burrowing which separates the mucosa from the serosa shows a tongue-like extension towards the pylorus. Occasionally there is encountered a large shallow ulcer with marked infiltration of the adjacent wall or deformity due to perigastric inflammation. Perforation into an adjoining viscus with fixation in sclerosed tissues not only results in a constant deformity but in one which is unchanged by medical treatment. Circumtrization may leave a stiffened unchanging indented segment simulating neoplasm and partially distinguished from it only when there are radiating folds.

INDIRECT SIGNS

Location of the Niche—A typical rounded projection from the vertical portion of the lesser curvature that is from the incisura angularis

By contrast, a niche on the horizontal portion of the lesser curvature should be regarded as suspicious of neoplasm even though its appearance is benign. Statistics vary but most authors agree that the niche in this portion is much more often malignant than benign. Interestingly, benign ulcers in this area frequently are not demonstrated by a niche.

Ulcers about the cardia and the subcardiac area as well as those

on the anterior and posterior walls, are also more often malignant than benign but the difference in frequency is not sufficient to be of value in considering the individual case. By contrast, ulcer on the greater curvature is almost always malignant, while a true pyloric ulcer is likely to be benign.

Size of the Crater.—The statement often made that an ulcer larger than three centimeters in diameter is malignant is erroneous. Large ulcers often are benign. However, the large ulcer which is shallow, irregular in outline or triangular in shape should be regarded with suspicion. It is noteworthy that, not infrequently, a tiny niche may represent the erosion of a small cancer. Crater size, therefore, is of no value in differential diagnosis.

Depth of Crater.—The ulcer niche which projects well beyond the normal position of the lesser curvature is likely to be benign, the bulk of the malignant niche is generally within the gastric contour. The perforated ulcer is likely to be benign and differentiation from malignant ulcer is not difficult because the perforated malignant ulcer is usually associated with frank roentgen signs of carcinoma.

Spastic Phenomena.—A single deep incisure is somewhat more often associated with benign ulcer. Antral spasm secondary to an ulcer on the vertical portion of the lesser curvature has already been referred to. The contraction waves opposite a malignant ulcer are usually shallow, broad and irregular. They are usually multiple.

Associated Lesions.—The demonstration of a definite duodenal ulcer with a niche makes the presence of malignant gastric ulcer unlikely. These lesions occur together rarely. However, the coincidence of benign ulcer and neoplasm independently in the same stomach is not rare (Yarnis).

The rate of gastric emptying is of no value in differential diagnosis.

CHANGE IN THE APPEARANCE OF THE NICHE

Rapid increase in size is usually a sign of malignant ulcer except when the niche is located on the vertical portion of the lesser curvature. Here, according to Gutmann, it is the slowly progressing lesion which is to be regarded with suspicion. On the other hand, Berg points out that as a benign ulcer shrinks, there is the possibility that the niche may temporarily appear larger.

Persistent or progressive irregularity in outline also is to be regarded as suspicious of neoplasm, particularly when this has occurred in spite of active therapy. These signs should be sought especially on the pyloric side of the niche.

The effect of active ulcer therapy on the size of a niche is of utmost importance in differential diagnosis. Whether a malignant ulcer can heal is disputed. Certainly it is at best a rare occurrence. On the other hand healing may be simulated roentgenologically when the niche is partly filled with debris or blood clot. Progressive diminution in size followed by complete disappearance is characteristic of a benign lesion and this sequence must have occurred before the diagnosis of benign ulcer can be made with certainty. Many ulcers which give the roentgen appearance of calloused lesions respond to therapy since much of the change may be due to edema. When therapy is active regression should be demonstrable in three to four weeks and doubtful cases should be re-examined at this interval.

Ordinarily a slight change in size and involvement

a slight change in details but that part which is rigid and ulcerated remains unchanged except to progress slowly.

It follows therefore that an ulcer which shows no regression on active therapy while it may be benign and calloused, must be regarded as suggestive of neoplasm. It is this type of case which is ordinarily subjected to resection if there are no clinical contraindications partly to cure a recalcitrant ulcer partly to remove a possible neoplasm.

Disappearance of clinical symptoms but persistence of the niche present a diagnostic difficulty. A niche on the vertical portion of the lesser curvature which tends to regress is usually safely kept under observation. Lesions elsewhere particularly when there is no tendency to regression must be considered as suspicious of malignancy.

SUMMARY

The roentgen examination often does not provide an unequivocal differentiation between benign and malignant ulcer. The changes around an inflamed or calloused benign ulcer may simulate neoplastic infiltration. However the more extensive rigid and constant the changes are the more one is suspicious of cancer. When the niche projects from a rigid indentation or depression into the gastric contour malignant ulcer must be suspected. Only ulcers on the vertical portion of the lesser curvature may be temporized with and possibly some which show radiation of mucosal folds towards the niche. The latter is more frequently a sign of benign ulcer.

When the clinical and roentgen findings along with esophagoscopy or gastroscopy fail to provide a definite diagnosis only the course of

the disease during active ulcer therapy can provide the information required for the proper treatment of the patient

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MALIGNANT DEGENERATION OF CHRONIC BENIGN GASTRIC ULCER

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THE problem of the possible etiological relationship between chronic gastric ulcer and carcinoma is of more than academic interest,

degeneration to form the so called ulcer carcinoma, with even a few who view most ulcerating lesions of the stomach with grave concern and advocate prompt surgical treatment as a routine prophylactic measure.

INCIDENCE

Comprehensive surveys of the literature^{1, 2, 3} have found a wide variation in the reported frequency of malignant change in chronic callous ulcer based on pathologic studies. While the statistical figures included extremes between zero and 90 per cent, those of the majority of authors showed an incidence of less than 10 per cent, with an average of about 2 to 5 per cent.

Clinical observations also provide data of considerable interest. Gastroenterologists of wide experience,^{4, 5, 6} after following large numbers of gastric ulcer patients for years, have noted very few, if any, instances of verified secondary carcinomatous development. Based on clinical experience and a critical review of the literature, one authority⁷ concluded that carcinoma of the stomach and peptic ulcer are distinct diseases, and that cancer probably does not occur any more often in a gastric ulcer than should be anticipated in the population as a whole. However, cases have been encountered in which carcinoma developed at a sufficiently later date following gastroenterostomy for supposedly benign gastric ulcer to warrant the assumption that the original lesion was benign and had subsequently undergone neoplastic degeneration.^{4, 8}

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PATHOLOGIC CONSIDERATIONS

It is by no means simple to prove pathologically that a particular ulcerated carcinoma has originated in a previously benign peptic ulcer. It is well known that ulceration of a primary malignant growth



Fig 142—A Photograph of an ulcerated gastric lesion believed to be a benign chronic peptic ulcer in which malignant change has occurred. Note the typical form of chronic callous ulcer. P indicates the proximal side of the specimen.

B Photograph of longitudinal section of the ulcer. Note the overhanging superior lip and the sloping distal margin of the ulcer. The arrow points to the sharply demarcated muscularis turned up into the edge of the ulcer.

(Figures 142-148 reproduced through the courtesy of the American Medical Association Press.)

may produce the gross and microscopic appearance typical of chronic callous ulcer^{2 3 9 10 11 12 13 14} (Figs 142-146). Both benign or malignant ulcer may be round, oval or eccentric in contour with smooth margins, a steep, overhanging superior edge and a gradually sloping



Fig 143—Low power photomicrograph of a section taken from the block shown in Fig 142. *B* Arrow *a* points to localized area of carcinoma at the distal edge of the ulcer, arrow *b* indicates the fusion of the muscularis mucosae and muscularis propria, and *c* marks the characteristic callous ulcer base, in which the muscularis has been completely destroyed

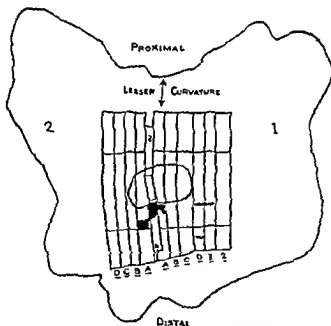


Fig 144—Composite relief drawing made from microscopic examination of sections of serial blocks to show the location and extent of the carcinomatous growth. The solid black areas represent multiple neoplastic foci. The base of the ulcer is entirely free of cancer

distal border. As is characteristic in primary benign ulcer,² secondary peptic ulceration of a carcinoma may also completely destroy the segment of muscularis in the ulcer floor, and the sharply demarcated ends of the muscle layer then turn upward into the ulcer margin. Even the approximation or fusion of the muscularis mucosae and muscularis propria in the edge of the ulcer, thought to be pathognomonic

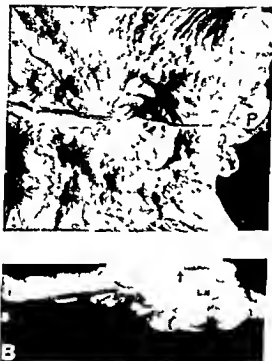


Fig 145—A Photograph of an ulcerated carcinoma. Note the typical gross appearance of chronic peptic ulcer. P indicates the proximal side of the specimen.
 B Photograph of longitudinal section of the ulcerated carcinoma. Note similarity to the section in Fig 142, B. LN indicates metastatically involved lymph node.

of primary benign ulceration² may be observed in obviously primary carcinoma that has undergone peptic ulceration.²

In view of the frequent close similarity between primary callous ulcer and ulcerated gastric cancer and the lack of any specific anatomic feature which would indicate the pre-existence of a benign lesion, an unequivocal pathologic diagnosis of "ulcer-carcinoma" is

possible only in the few cases which can meet certain strict criteria^{3 12 14} These conditions require that (1) The lesion exhibit the characteristic pathologic features of chronic peptic ulcer, (2) the malignant process be localized to a narrowly circumscribed area of the ulcer margin, (3) the ulcer base be free of cancer or at least only slightly infiltrated adjacent to the focus of origin of the neoplastic growth Obviously, this ideal picture may be observed only when the lesion is examined in its earliest phase of development (Figs 142 143 144) In later stages, overgrowth of the primary ulcer by carcinoma renders the diagnosis extremely difficult or impossible

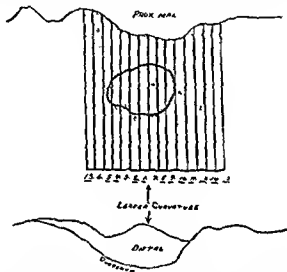


Fig 146—Composite relief drawing showing the wide distribution of the carcinomatous infiltration represented by the stippling

Great care must be exercised in the pathologic interpretation of the benign cellular atypism and heterotopia so often seen in the mucous membrane of peptic ulcer margins in order to avoid an erroneous conclusion that malignant change has taken place

Two further sources of error must also be borne in mind Ulcer and carcinoma may occur independently in the same stomach in close approximation to each other and by their progressive growth finally meet thus creating the illusion of a carcinoma arising in the margin of a chronic benign ulcer^{3 11 12 14} Another source of confusion is the possibility that a primary new growth may undergo total or almost complete destruction leaving but little, if any, carcinomatous tissue,



Fig 147—Photograph of a "ring form" gastric carcinoma. Note gross appearance of chronic peptic ulcer

PROXIMAL

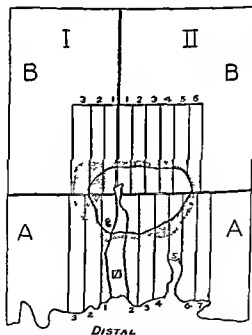


Fig 148—Composite relief drawing showing the "ring form" carcinoma depicted in Fig 147. The base of the ulcer exhibits only very slight carcinomatous infiltration.

so that what little remains can be found only after careful microscopic search^{11 13 15 16} This mechanism may explain the evolution of the ring form carcinoma which consists of a cancer free typical peptic ulcer base surrounded by a circle of residual carcinoma^{11 14} On the other hand a similar "ring" neoplasm may have its origin in a primary peptic ulcer in whose margins carcinomatous degeneration has occurred in simultaneous multicentric foci¹⁷ (Figs 147 148)

CLINICAL CONSIDERATIONS

As has been emphasized¹⁸ there are no reliable criteria even after the most careful clinical study of the individual case by which one can be sure that early cancerous changes have taken place in an apparently benign gastric ulcer

A long clinical history cannot be utilized as an indication of pre-existent ulcer any more than a short history is conclusive evidence of malignant disease⁷ Many cases of gastric cancer present long antecedent histories of digestive complaints suggestive of ulcer^{8 19} but one should not overlook the fact that conditions other than ulcer may produce similar symptoms e.g. functional gastrointestinal disturbances gallbladder disease hiatus hernia chronic gastritis and others

Scirrhus carcinoma may produce an illness of several years duration^{8 9} so called "chronic" carcinoma in contradistinction to the "acute" form has also been described²¹

In reviewing the relative accuracy of various methods employed in the differential diagnosis of primary and malignant gastric ulcer² it was found that the diagnosis was correct in a larger percentage of cases when it was based on the histamine gastric analysis³ than when any other single method was relied upon It has been conclusively demonstrated that a benign ulcer with achlorhydria is very unusual⁴ On the other hand it is well known that ulcerating neoplasms are not infrequently associated with a normal or high acidity^{7 4}

Due to the high degree of accuracy of the roentgen and gastroscopic examinations in trained hands and the aid afforded by the gastric analysis the clinician is fortunately confronted with but a relatively small number of cases in which the final judgment of the benign or malignant nature of the gastric lesion must await the report of microscopic examination of the resected stomach

MEDICAL VERSUS SURGICAL TREATMENT OF UNCOMPLICATED CHRONIC GASTRIC ULCER

Gastric resection would certainly seem to be indicated in patients presenting an ulcerated gastric lesion situated in the antrum and

associated with the determination of low or absent free hydrochloric acid in the gastric secretions. Other cases with equivocal chemical, roentgenographic and gastroscopic findings are deserving of a period of observation under medical treatment before being considered for surgery. If under an adequate medical regimen over a period of two or three weeks the patient experiences little or no clinical improvement or the gastric defect fails to show a decrease in size when viewed in the roentgen and gastroscopic examinations malignancy should be suspected and operation delayed no longer.⁶ However it

cal treatment²³ but may relapse at a later date. One should therefore not be satisfied until complete and permanent healing has been demonstrated.

In the long run it is felt that the best interests of most patients with uncomplicated gastric ulcer will probably be served if they are treated conservatively, reserving surgery for those whose symptoms prove intractable to strict medical care or who develop a change in the character of their clinical picture or suspicious alteration in the size or appearance of the lesion.

One must not lose sight of the fact that even in the hands of experienced surgeons gastric resection is not without an appreciable mortality. Based on forty-six reports in the literature the average mortality of gastrectomy for peptic ulcer was found to be 6.8 per cent. However this figure is probably excessive, having been considerably reduced in recent years by improved operative technique and the use of better preoperative preparation, improved anesthesia, chemotherapy and blood transfusions. Nevertheless even with a mortality rate following gastric resection of only 2 or 3 per cent which approximates the generally accepted incidence of malignant change in chronic gastric ulcer routine prophylactic gastric resection would probably save no more lives from secondary malignant degeneration than would be lost because of the mortality associated with the operative procedure. Furthermore very few patients with ulcerated carcinomas of the stomach even when operated upon as soon as they present themselves are eventually cured by any of the operative procedures presently employed.⁷

SUMMARY

The incidence of malignant change in chronic peptic ulcer of the stomach is probably about 2 to 5 per cent. As yet there are no known

criteria by which such neoplastic transformation may be clinically diagnosed with certainty

That carcinoma has developed in a simple ulcer may be proved only if the lesion can be studied pathologically in its earliest stages of evolution. Even then, the validity of the strictest criteria employed may be open to criticism. In advanced "ulcer carcinoma" it is not possible to demonstrate histologically that chronic benign peptic ulcer was the precursor of the malignant growth.

Secondarily ulcerated carcinoma may exhibit in every detail the gross and microscopic features characteristic of simple peptic ulcer. Fortunately present methods of clinical diagnosis enable the physician to differentiate accurately between benign and malignant ulcers of the stomach in the majority of cases.

In equivocal cases it is felt that an initial trial of medical therapy is indicated, surgery to be recommended if the suspicion of malignancy be confirmed by failure of the lesion to respond to an adequate regimen. Patients must be maintained under close surveillance however since carcinoma may at times exhibit temporary clinical roentgenographic and gastroscopic improvement under medical treatment only to undergo subsequent exacerbation.

There is insufficient evidence to warrant a recommendation of routine surgical treatment of uncomplicated chronic gastric ulcer as prophylaxis against possible secondary malignant degeneration.

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COEXISTING ULCER AND CANCER OF THE STOMACH

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THE presence of a benign ulcer and an independent carcinoma in the same stomach is an unusual occurrence. The following three cases were admitted to the Gastric Surgical Service of the Mount Sinai Hospital within three years.

CASE I. F. M., a Puerto Rican male aged 55 years, was admitted January 13, 1941. For ten years he had been subject to attacks of left upper quadrant pain beginning soon after meals and persisting for ten hours. At the onset the pain recurred once weekly during the four months preceding admission; the pain was more frequent and severe and was associated with abdominal distention and vomiting. The stools were never bloody or foul. Bowel movements were regular and he passed an occasional tarry stool. Anorexia was marked and he lost 45 pounds. Five years previously he had received intra-venous and intramuscular injections and ten years before this admission he was hospitalized for an extensive bilateral pneumonia. At that time the blood Wassermann was negative and he had digestive complaints.

Physical examination revealed a poorly nourished male presenting evidence of a marked weight loss. The heart, lungs and blood pressure were normal. The abdomen was soft, no mass was palpated. In the right axilla a firm lymph node was palpated. The lungs were clear and revealed no evidence of tumor cells. The clinical impression was that this patient was suffering from a gastric malignancy.

Examination of the blood revealed 64 per cent hemoglobin, 3,500,000 erythrocytes, 6000 leukocytes, with 45 per cent polymorphonuclear leukocytes, 43 per cent lymphocytes, 9 per cent monocytes and 3 per cent eosinophils. The stool contained occult blood. Gastroanalysis after the Rehfuess test meal revealed a free acidity of 16 and a total acidity of 39. The blood Wassermann was negative. The blood chlorides were 560 mg. per 100 cc. and the carbon dioxide combining power was 11 volumes per 100 cc.

Radiographic examination of the stomach after a barium meal revealed complete retention of the barium at the six hour observation. The antrum was incompletely visualized due to a marked retention of food. The duodenal bulb was not visualized. The x-ray appearances suggested complete pyloric obstruction due to an organic lesion. The exact location of the lesion and whether it was benign or malignant could not be determined from this examination (Fig. 149).

Gastroscopic examination of the stomach revealed an ulcer about 2 cm. wide on the lesser curvature at the angularis. The margin of the ulcer was sharply

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dehimated and there were a few rugae radiating directly to the edge. This appearance was typical of a benign healing ulcer. Peristalsis was absent and the distal half of the antrum was not visualized.



Fig. 149—Pyloric carcinoma causing complete gastric retention and benign ulcer at the re-entrant angle

The patient was treated with antispasmodics, daily gastric lavages and intravenous blood and fluids. He gained 6 pounds but his gastric retention still exceeded 500 cc. so that surgical exploration was performed. Laparotomy revealed a large mobile pyloric neoplasm adherent to the pancreas and at the re-entrant angle there was a thickening which subsequently proved to be the

scar of a healed ulcer. A subtotal gastrectomy and gastrojejunostomy with the aid of a Murphy button were performed. Pathologic examination of the stomach revealed an ulcerated cauliflower mass in the pyloric region. This tumor encircled the entire pylorus and invaded the stomach wall completely. Numerous enlarged lymph nodes were found in the attached omentum. On the lesser curvature at the re-entrant angle was a shallow ulcer. Five centimeters of normal mucous membrane separated the ulcer from the prepyloric carcinoma. The pathologic diagnosis was infiltrating adenocarcinoma of the stomach with metastatic involvement of the gastric lymph nodes and a chronic peptic benign ulcer where no tumor cells were seen. The patient failed to report one year later to the follow-up clinic and presumably died.

Comment.—The anorexia, vomiting, weight loss and cachexia produced a clinical picture suggestive of malignancy. This diagnosis was supported by the anemia, hypoacidity and blood in stool. Gastric x rays revealed an almost complete pyloric obstruction, the nature of which could not be definitely determined. Gastroscopy revealed a benign healing ulcer. Despite daily lavages, a high degree of gastric retention persisted, and surgical intervention was necessary.

CASE II.—L. P., a white man aged 64 years, was admitted September 20, 1943. For one year he had noticed burning epigastric pain recurring with hunger and relieved by food. The pain became progressively worse and frequently radiated

and he lost 15 pounds in six months. He had undergone a right hernioplasty fourteen years previously. Chest x ray disclosed a healed bilateral apical tuberculosis.

Physical examination revealed a well developed Italian male and was essentially negative except for a recurrent inguinal hernia. Examination of the blood revealed 93 per cent hemoglobin, 5,100,000 erythrocytes and 7900 leukocytes with 65 per cent polymorphonuclear leukocytes, 33 per cent lymphocytes, and 2 per cent monocytes. The guaiac test of the stools was negative. Gastric analysis after the Rehfuss test meal revealed a free acidity of 50 and a total acidity of 70. The blood chlorides were 610 mg. per 100 cc. and the carbon dioxide combining power was 60 volumes per 100 cc.

Gastrointestinal examination by means of a barium meal performed before he entered the hospital revealed a dilated stomach with a large ulcer crater on the lesser curvature of the body above the re-entrant angle. There was also a rather constant narrowing of the prepyloric region. The roentgen appearance suggested a benign gastric ulcer and the antral deformity was interpreted as due to spasm. There was a 30 per cent residue at the six hour observation (Fig. 150).

Gastroscopy revealed an ulcer about 2.5 cm. wide on the lesser curvature just proximal to the angularis. The ulcer margin was sharp but reddened. On the posterior wall of the corpus near this ulcer there was a similar superficial ulcer about 5 mm. wide. The entire gastric mucosa was markedly reddened, edematous

and covered with translucent exudate. Peristalsis was sluggish and appeared to progress to the pylorus. The gastroscopic impression was active benign gastric ulceration with severe superficial gastritis.



Fig. 150—Benign ulcer above re-entrant angle and infiltrating prepyloric carcinoma.

Because of the gastritis and gastric retention the patient was treated with daily lavages for two weeks and then subjected to exploration. On the night before operation the gastric retention was 700 cc. Laparotomy revealed a distinct thickening at the re-entrant angle and adhesions around the pylorus and duodenum. The entire gastric wall was thickened and dematted. The stomach

was most pronounced in the prepyloric region but the serosa here appeared normal. A subtotal gastrectomy and jejunostomy for alimentation were performed.

Pathologic examination revealed a reddened gastric mucosa covered with bloodstained mucus. An ulcer measuring 1.5 cm in diameter was found straddling the lesser curvature at the re-entrant angle. On the posterior wall near this ulcer was a stellate scar. The mucosa was freely movable everywhere except for the region 1.5 cm proximal to the pylorus. Here the mucosa was fixed, firm and presented a serpinginous elevation which encircled the pylorus. The ulcers were separated from the carcinoma by 6 cm of normal mucosa. The pathologic diagnosis was infiltrating adenocarcinoma of the prepylorus and chronic peptic ulcer of the lesser curvature. No involved lymph nodes were found. This patient was symptom free when seen in May, 1946.

Comment—Despite the advanced age of the patient, the clinical aspects favored a benign lesion. The normal blood picture, hyperacidity and absence of blood in the stool were consistent with this diagnosis. Roentgen studies revealed a large dilated stomach with a benign ulcer at the incisura angularis. There was a prepyloric defect and a 30 per cent six hour residue. These were explained as due to reflex antral spasm. Gastroscoopically, multiple gastric ulcers and a severe superficial gastritis were observed. On intensive ulcer therapy including lavages, the retention rose from 600 cc to 700 cc and operation was necessary.

CASE III—II B a white man aged 58 years, was admitted on November 22, 1943. Eight years previously he had recurrent epigastric pain which was treated with diet and twenty four daily injections. The pain disappeared after two months and he was relatively asymptomatic until eighteen months before this admission. Then the epigastric pain recurred almost daily for three months. He was again symptom free until two weeks before he was admitted. The pain recurred two to three hours postprandially and was promptly relieved by food. He had one episode of nausea and vomiting associated with the pain during the last recurrence. His appetite was poor and he lost 9 pounds. The bowels were regular and there was no rectal bleeding. Physical examination revealed a well nourished male and a firm lymph node was palpated in the left axilla. This was biopsied and showed no involvement by tumor. The heart and lungs were normal. There was a sense of resistance in the right epigastrium but no definite mass was palpated. Examination of the blood revealed 84 per cent hemoglobin, 11,500 leukocytes with 83 per cent polymorphonuclear leukocytes, 13 per cent lymphocytes, 2 per cent monocytes and 2 per cent eosinophils. The guaiac test of the stools was negative. Gastric analysis after a Rehfuess test meal revealed a free acid of 16 and a total acid of 40.

Roentgen examination of the stomach after a *barium meal* performed before he entered the hospital revealed a shallow projection from the lesser curvature at the region of the re-entrant angle. There was a slight irregularity of the lesser curvature on each side of this ulceration, which measured 2.5 cm. in diameter. Opposite the latter on the greater curvature and posterior wall of the corpus, there was a filling defect about 3 cm. wide. In the center of this defect was a

projection, apparently an ulcer crater (Fig 151) There was no residue at the six hour observation.

Gastroscopy revealed a large ulcerating lesion on the posterior wall adjoining the lesser curvature. The edges appeared everted and the distal margin was at the angularis. Because of the marked friability and bleeding of the tissue on the



Fig 151 --Ulcerated infiltrating carcinoma on greater curvature and shallow benign ulcer at re-entrant angle

posterior wall, the upper limits of the ulcer were not visualized. The gastroscopic impression was that the lesion was a large carcinomatous ulcer.

At operation the stomach was found to be the seat of a carcinomatous ulceration on the greater curvature, and a distinct lesion on the lesser curvature opposite this which was also suspected as being a carcinoma. Because of the extent

of the carcinoma and the extensive involvement of the lesser curvature lymph nodes to the cardia, a total gastrectomy with esophagojejunostomy and jejunostomy for alimentation was performed. The patient made an uneventful recovery and was discharged from the hospital on the thirty third postoperative day.

The resected specimen consisted of the entire stomach from pylorus to cardia and in the region of the greater curvature 10 cm. proximal to the pylorus there was a flat tumor mass 5 cm. wide. Its surface presented small irregular ulcerations. On section the tumor tissue showed streaky infiltration into the muscularis. Opposite this on the lesser curvature there was a separate ulcer with a grayish white base and a firm, slightly raised edge. There was an area of normal mucosa measuring 3 cm. between the ulcer and the cancer. The attached lesser and

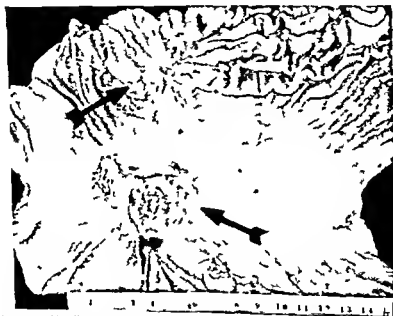


Fig. 152.—Totally resected stomach with large peptic ulcer and infiltrating scirrhous carcinoma.

greater omenta contained numerous nodes with irregular whitish areas which suggested gross involvement by tumor. The pathologic diagnosis was infiltrating scirrhous carcinoma with involvement of the gastric lymph nodes and a large chronic peptic ulcer (Fig. 152).

This patient was on a regular diet and worked hard for two years when he died suddenly. Cause of death was infarction of the entire small intestine due to mesenteric thrombosis secondary to torsion about an adhesion. Postmortem examination revealed no evidence of metastases.

Comment—The episode of epigastric pain eight years previously, and perhaps that one of eighteen months before suggested the pos-

projection, apparently an ulcer crater (Fig 151) There was no residue at the six hour observation

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SUMMARY

1 Peptic ulcers above the incisura angularis may cause mild degree of gastric retention

2 Gastric retention exceeding 50 per cent of the ingested barium meal should suggest a benign or malignant pre- or postpyloric lesion

3 Persistent gastric retention should not be attributed to an ulcer at a distance from the pylorus, particularly when healing of the ulcer is observed

4 Peptic ulcers in the body of the stomach may heal in the presence of a malignant growth causing pyloric obstruction

5 When the clinical picture is atypical the presence of a benign gastric ulcer should not preclude search for an independent carcinoma which does not originate in the ulcer

sibility of a long standing peptic ulcer. The recent weight loss and anorexia, however, were suggestive of malignancy. The laboratory findings were equivocal. The blood picture was normal and the stools were guaiac negative, but there was a hypoacidity. Both x ray and gastroscopic studies suggested malignancy.

DISCUSSION

Two cases presented here were associated with the clinical picture of typical malignancy and the third appeared to have a benign ulcer. The laboratory findings were consistent with these diagnoses except in the third case in which blood was absent from the stools. In both of the cases with pyloric obstructions there was no alkalemia.

Antral spasm secondary to ulceration above the incisura angularis may cause mild degrees of gastric retention. However, high grade pyloric obstruction, causing six hour residues exceeding 50 per cent of the ingested barium meal, must be due to a pyloric or juxtapyloric lesion. In the first case the complete pyloric obstruction could not be attributed to the healing ulcer at the angularis. In the second case the gastric retention which persisted despite the healing of both corporic gastric ulcers should suggest therefore an associated benign or malignant juxtapyloric lesion. It is well to remember that in about 8 per cent of cases gastric ulcers are associated with duodenal ulcers.

Resected specimen of the first case revealed the scar of a healed ulcer. In the second case the larger ulcer decreased to one-half its former size and the smaller ulcer healed despite the presence of a prepyloric carcinoma. This is in contrast to the observation of Bockus who noted the absence of healing of ulcers distant from the pylorus when there was a persistent or high grade pyloric stenosis. In the third case when the ulcer and the carcinoma were in the body of the stomach, no healing of the large peptic ulcer was observed.

Gastroscopically a small benign ulcer was discovered in the first case. The prepyloric region was not visualized because the pylorus was fixed to the posterior abdominal wall by an adherent carcinoma. In the second case multiple benign ulcers and a severe gastritis were observed. The marked edema, producing a swollen boggy mucosa was sufficient to mask any mucosal abnormality caused by the infiltrating neoplasm. The gastroscopist in the third case noted a large ulcer with an irregular margin, erroneously suggesting a carcinomatous ulcer. In addition, the presence of a typical infiltrating neoplasm only 3 cm away produced the gastroscopic picture of an extensive malignancy with ulceration.

PEPTIC ULCER AS A PSYCHOSOMATIC DISEASE

BURRILL B. CROHN, M.D., F.A.C.P.*

SINCE the awakening of medicine, the reaction of nervous systems of the human body to psychic disturbance has been recognized. Nervous vomiting, diarrhea, spastic constipation, flatulence, heartburn, all as a result of sustained emotional conflict, have long been accepted. But that continued psychic strain could actually produce, in a viscus, an organic, pathologic process, what we today regard as a psychosomatic disease, is, if not a modern concept, certainly a recently accepted fact.

ETIOLOGY OF PEPTIC ULCER

The actual cause of peptic ulcer has never been understood. The vagus nerve system has been early implicated by Rokitsansky, Eppinger and Hess with their theory of vagotonia stressed the relationship between vagal stimuli and gastrointestinal disturbances. Von Bergmann offered the hypothesis of the origin of ulcer in spasmodic contractions of the afferent vessels of the muscular wall of the stomach. But of all the ancient and discarded theories of the etiology of ulcer no one of them seemed to make sense until the observations of Schiff, of Claude Bernard and of Brown Séquard, who associated experimental lesions of the optic thalamus of animals with sequential gastric lesions such as gastromalacia and perforation.

Association between Brain Lesions and Peptic Ulcers.—To the modern generation it was Harvey Cushing's publication in 1932 of the association between brain lesions, particularly cerebellar tumor and abscess, and peptic ulcers that first focused attention on ulcer as a consequence of organic cerebral processes. Cushing concluded with the statement that there is strong evidence which suggests the presence in the diencephalon of a parasympathetic center. Further and later studies by anatomists and physiologists established the fact that from the hypothalamus and tuber cinereum fibers were relayed through the midbrain and medulla, the vagal nuclei, thence by way of the vagi to the gastric wall.

Beatue¹ has demonstrated that stimulation of the hypothalamus causes both increased peristalsis and increased secretion within the stomach (experimental). Others² have shown an inhibition of tone

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Beattie¹ has demonstrated that stimulation of the hypothalamus causes both increased peristalsis and increased secretion within the stomach (experimental). Others² have shown an inhibition of tone

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and peristalsis following hypothalamic stimulation, thus proving a direct relationship between midbrain, parasympathetic nervous system and the viscera. Keller³ has demonstrated extreme congestion, even hemorrhage of the gastric mucosa following experimental injuries of the midbrain of dogs. Mucosal ulcerations resulted when the same experiment was performed on monkeys (Hoff and Sheehan⁴).

The relationship of the midbrain and hypothalamus to the vagi and to the viscera having been experimentally established, the question arose as to what, in the human, would furnish such an excessive stimulus to the hypothalamus as to produce organic disease. Beaumont⁵ with his wonderfully apt subject, Alexis St. Martin, could study and convincingly manifest universal changes of color and secretion within the stomach as the result of emotions, including anger, as could Carlson with his analogous subject.

Psychosomatic Theory.—More recently Wolf and Wolff⁶ have had a unique opportunity to correlate data which might support the psychosomatic theory of the causation of peptic ulcer. In their gastrostomized man they could study on the exposed gastric mucosa the changes produced by emotional tensions. Secretory, vascular and motor changes were correlated with psychic disturbances. At times following resentment and anxiety or hostility the gastric mucosa would become red and engorged, the mucosal folds thick and turgid, and even small bleeding points and erosions were produced by moderate trauma.

The concept of ulcer as a trophoneurosis is furthered by such an interesting observation as that of Moolten.⁷ A young man, diving struck his head and sustained a fracture of the fifth and sixth cervical vertebrae. He lived seventeen days and died, not directly of his spinal laceration but from the fatal hemorrhage of a duodenal ulcer. The cerebral stimulus to the disorientation of the sympathetic control has been represented by such writers as Franz Alexander, Moschicowitz, Draper and others. The psychic constitution and the anatomic substrate build up to a spare thin man, overanxious, overambitious, one assuming to carry too much responsibility, a product of the ever tense social, industrial and technocratic advances of the times reacting upon a constitutionally exposed sympathetic nervous system.

If this theory of ulcer as a psychosomatic manifestation be correct, then ulcer should increase during periods of tension and frustration in human life and should be a reflection of eras in civilization of civil war and international strife. The fact of the matter is that ulcer is prevalent in the turbulent period of adolescence, is remarkably repre-

sented in highly emotional persons, particularly professional classes, and has apparently increased with the modernization of industry and the increased tempo of life. Ulcer during the recent war became a problem of greatest significance not only in the armed forces but in the civilian population as well. Both the incidence of ulcer and of its complications, particularly hemorrhage, apparently increased following the outbreak of World War II, are said to have increased in England following the Dunkirk retreat, and became a problem of first magnitude in our own selective service, our army and navy, and in the highly anxious and emotional civil population during the trying crises of recent events.

The personal lives of most adolescents and adults today are likely to be a succession of tensions, frustrations, emotional struggles, domestic and family problems. In no field of medicine are there to be found a greater number of neurotics, psychoneurotics and sufferers from functional disturbances than in the realm of the gastrointestinal tract, and yet only 5 or at most 10 per cent develop or have developed peptic ulcers. The x factor which determines the 5 per cent who are to suffer from active ulcer has not been discovered. It is not acid in the gastric secretions alone, for it is presumed that in young life all men and women have free acid in their gastric secretions, the exceptions are only a small number. That individuals with ulcer have a constitutional factor which is unique and characteristic in contradistinction to the control population, as claimed by the theories of Draper, Kretschmer and Moschcowitz, is hardly tenable and cannot be sustained in everyday practice. Therefore, given the psychic factor, the hypothalamic disturbance of control, the vagal irritation, the acid gastric secretion plus the unknown x factor, in 5 per cent of the population peptic ulcer occurs. This still does not prove that the psychic conflict produced the somatic disease, except in individuals preconditioned to ulcer.

EXAMPLES OF ULCER RECURRENCE INITIATED BY ANXIETY

If in theory the psychosomatic etiology of ulcer falls entirely short of proof, in clinical practice one startling fact emerges, namely, the periodic recurrences of peptic ulcer are most frequently initiated by an anxiety state. In a quiescent and presumably healed ulcer, a fright, a protracted anxiety or a period of mental strife will often be the cause of an ulcer recurrence. Let us take from everyday clinical practice some of the examples that clearly demonstrate such an occurrence.

A mother who for five years had been free of duodenal ulcer symptoms anxiously awaited for eight hours the arrival of a lost airplane carrying her son back from military service immediately she suffered recurrence of severe ulcer symptoms The father of a boy had been free of his ulcer for seventeen years when his son was inducted into service at the height of the Philippine campaign immediately ulcer symptoms recurred An old man heard the horrifying details of the massacre of his family in a concentration camp in Germany days later ulcer symptoms reappeared

An emotional individual who had apparently been healed of his ulcer symptoms for years was the subject of a terrifying hold up there was recurrence immediately This same anxious man sustained a recurrence of his ulcer each time during the ninth month of his wife's pregnancies

A woman fifty years of age was for ten months under the anxious strain of nursing her father suffering with a carcinomatous cachexia within a few days of the father's death there occurred the onset of active ulcer symptoms After control induced improvement recurrence was created by the serious and simultaneous illnesses of her two children Again she lapsed into a recurrence which terminated this time by the sudden death of her husband of coronary thrombosis

The sequence of events in the life history of a lawyer is most instructive In July 1944 his unmarried daughter became pregnant This was followed by a forced marriage and a subsequent abortion Within one month the onset of epigastric pain relieved by milk and food was noted Four weeks later a sudden perforation of a duodenal ulcer confirmed by operation closed an eight weeks course of aggravation anxiety ulcer pain perforation and emergency operation

A perfectly well woman at the termination of war hostilities suddenly found herself the head of an artificially enlarged family Each of the two sons in law upon discharge from the army moved in on her bringing with them

daughters and four
becoming home-

Upon the life history of peptic ulcer A man whose ulcer had been healed for years undertook after the cessation of war to reestablish his business associations in Europe He found everything in discord in France his business attempts in Belgium were frustrated the food was bad his reception by his for

mer associates was cold and his plans, undertaken at great cost and effort, came to naught Two days after his arrival home by plane he had a sudden gross and serious recurrence

Another individual who had been well for years had a hemorrhage from an ulcer two weeks after the death of a mother to whom he had been dearly devoted

A successful lawyer was forced to relinquish his court appearances because every time he was called upon to try a complicated case in court, his services were terminated by a gastric hemorrhage from his otherwise latent ulcer

SUMMARY AND CONCLUSIONS

The foregoing examples, illustrating the recurrence of ulcer symptoms of hemorrhage and even of perforation immediately following severe psychic trauma, seem to indicate that psyche and soma are herein closely related in time and in sequence The recurrence of symptoms in a latent ulcer seems to create a better example of a psychosomatic disease than the original occurrence

If ulcer is a psychosomatic disease, then its cure should be susceptible to psychoanalysis to psychic suggestion and control to sedatives and to mental rest Unfortunately the ulcer once established is often a Frankenstein and becomes out of hand and beyond control by such obvious, simple measures A patient who will alter his way of life, limit his ambitions, control his emotions, adopt complacency and equanimity will help to establish the cure of his ulcer By the same token one who is unwilling to know himself and unable to control himself emotionally and mentally defeats his cure and remains a refractory subject for whom permanent relief can rarely be vouchsafed or insured For such an individual, surgery, particularly subtotal resection of the stomach with its resultant anacidity, is the obvious and most satisfactory cure But if anacidity be not achieved by such a resection, then a gastrojejunal ulcer may be expected and does occur in a small percentage of cases

At this point the situation seems about to be saved by the procedure of Dragstedt,⁸ a step which consists of the resection of both vagus nerve trunks above the diaphragm This operation has been performed often enough in recent years by a sufficiently diversified group of workers to assure a cure in practice of recurrent marginal ulcers By eliminating the psychic phase of gastric secretion, by inducing a relative anacidity, certainly in the earlier periods of the postdigestive secretory activity, a cure is motivated Dragstedt and

many other workers have practiced the same procedure of bilateral supraphrenic vagotomy for the cure of primary gastric and duodenal ulcer. If such a cure can be activated by the elimination of the psychic phase of gastric secretion then here we have at hand another evidence of ulcer as a psychosomatic disease. For by this procedure the tract—psyche, midbrain, vagus, stomach—is cut in its thoracic pathway, the psychic upheaval, the hypothalamic disturbance is neutralized in its effects upon gastric secretion, mobility and vascularity by the cission of the parasympathetic carriers. Ulcer as a psychosomatic manifestation ceases to exist and the ulcer heals.

If the future of bilateral vagotomy is as rewarding as the present is promising then not only will a great step in advance have been made in the curing and healing of ulcer but also the thesis of ulcer as a psychosomatic disease will have been fortified.

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GASTROJEJUNOCOLIC FISTULA

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GASTROJEJUNOCOLIC fistula is a complication of gastroenterostomy more serious and life threatening than the original lesion for which the procedure was employed. Spontaneous communications between the stomach, colon and small bowel as the result of carcinomatous involvement of these viscera, tuberculosis, pyogenic infection and foreign body penetration are very rarely encountered although such instances are recorded. In contradistinction, marginal or jejunal ulceration with secondary invasion of the colonic wall and perforation into its lumen is not infrequently seen in all large surgical clinics following gastroenterostomy. In almost all instances the original operation of gastroenterostomy was performed for duodenal ulcer. This corresponds with our own experience. The eight cases furnishing the basis of this report were operated upon originally for duodenal ulcer. Only a few cases are recorded in which fistula resulted following a short circuiting procedure for gastric ulcer. Two factors may account for this variance. The acid values in gastric ulcer are notoriously lower than in corresponding lesions of the duodenum. The second factor is the relatively much longer time that gastrectomy has been employed as the procedure of choice in the surgical management of gastric ulcer.

Incidence.—It is difficult to estimate accurately the frequency of gastrojejunocolic fistula. Ransom¹ reported eight cases with fistula in a series of forty seven with marginal or jejunal ulcer operated upon in a ten year period, an incidence of 17 per cent. We have treated a similar number surgically out of a total of forty four with stomal ulceration admitted to the gastric surgical service of the Mount Sinai Hospital during a thirteen year period. It will be appreciated that approximately one patient out of six who develops an anastomotic ulcer is exposed to the added complication of colonic involvement. Further evidence that gastrojejunocolic fistula is not uncommon is the relatively large number of cases reported by Judd² from the Mayo Clinic and by Marshall³ from the Lahey Clinic.

Age and Sex.—It is of interest to note that in our own experience all

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cases occurred in males. This corresponds to the findings of others. In a series of fifty two gastrojejunocolic fistulas reported by Judd² all were males but one. The youngest in our group was 37 the oldest 69. Three patients were in the fourth, one in the fifth, three in the sixth and one in the seventh decades of life. The literature records cases of fistula in patients as young as 20 and as old as 72.

Type of Previous Operation—In all our cases a posterior gastroenterostomy had previously been performed. In one case—the only fatality in this series—a second gastroenterostomy was performed in another hospital for symptoms suggesting marginal ulcer with hemorrhage. No case has been encountered in which partial gastrectomy was the primary procedure. This may be accounted for by the fact that for the past ten years we have been employing an anterior type of gastrojejunal anastomosis which effectively removes a possible anastomotic ulcer from intimate relationship to the mesocolon and colon with eventual perforation into the latter.

Time Interval between Primary Operation and Fistula—This subject poses many interesting problems because of the extreme variance that occurs between the original operation and the development of symptoms referable to the gastrocolic fistula. In two patients symptoms commenced twenty seven and thirty years after the gastroenterostomy. The shortest time interval was two years. In the vast majority of cases symptoms of recurrent ulcer were manifest for a considerable period of time before perforation into the colon was evident.

Symptoms—Diarrhea—This symptom was outstanding and the symptom that influenced the patient to seek surgical therapy. It occurred in all patients. It was surprising to find how long these patients carried on before entering the hospital. The shortest period of diarrhea was of three months duration as opposed to the longest which persisted for two years. The number of bowel movements was variable usually between six and twenty a day. The consistency and character of the stools varied also. In some they were described as "foamy" in others watery. Efforts to control the diarrhea were for the most part ineffectual. The question of whether the diarrhea is the result of the direct emptying of gastric contents into the colon through the fistula as evidenced by particles of undigested food in the feces or whether it is due to small intestinal irritative hypermotility is of interest. Clinical and x ray evidence would give some credence to the latter hypothesis. In one patient there was x ray evidence of only a jejunocolic communication. Diarrhea was nevertheless present.

Fetid Eructations and Vomiting—This symptom was as constant and as disturbing as was the diarrhea in all but one patient. In this case the barium enema showed a fistulous tract between the colon and jejunum without evidences of a direct gastrocolic opening. Vomiting was not as constant a feature. It occurred in two cases and was described as foul and 'fecal' in character.

Pain—Pain was a very variable and inconstant symptom. A careful history usually elicited the periodic pain of a jejunal ulcer occurring in cycles with exacerbations and improvement, especially when treated with bed rest and a strict ulcer regimen. With the onset of diarrhea the pain seemed to abate and on admission to the hospital was not outstanding. It is difficult to understand why this should occur in the presence of a large inflammatory process unless it can be explained on the grounds of an absence of penetration into the mesentery of the small bowel, which we have found to be persistently associated with pain of the severest character.

Loss of Weight—This was present in all our cases. The greatest loss in weight was 40 pounds in one patient, the least 10 pounds. The average loss was 20 pounds, in spite of an unimpaired appetite and a liberal diet in most cases.

Physical Findings.—Local—The local findings are usually meager. Tenderness on abdominal palpation is found in a small percentage of patients with the maximum point of sensitivity to the left of the umbilicus at a point on the level of the umbilicus. Slight protective abdominal spasm is sometimes found but true abdominal rigidity was not present in any case. No mass could be palpated through the abdominal wall although at operation a tumefaction the size of an orange was present in two cases.

General—The patient appears chronically ill. There is evidence of marked weight loss and inanition. The skin is dry and scaly and the normal integumentary elasticity is absent. The facial expression is not unlike that in a patient with acute dysentery. The eyes are sunken and the tongue dry and furred. The tongue is often glazed, cherry red, presenting lingual evidence of a marked degree of vitamin deficiency. Hemoconcentration because of fluid loss masks an anemia which reveals itself upon restoration of fluids. A low grade temperature is not uncommon.

Laboratory Findings.—In the main, gastric secretory studies revealed lower free and total acid values than ordinarily found in primary duodenal ulcer. In one patient there were 80 free and 128 total units of acid present. Blood proteins were uniformly low. In two

patients the values were reduced to 42 gm per 100 cc Blood chlorides were diminished and the carbon dioxide combining power of the blood was elevated because of loss of chlorides through the colon or because of vomiting Gastric retention was not marked, although vomiting was frequent and was thought to be caused by the irritating action of the colonic contents No studies on blood vitamins were



Fig 153—Shows barium enema with stomach outlined at same time

carried out In one patient with preoperative tetany there was a marked diminution in blood calcium In four patients methylene blue introduced into the rectum was promptly recovered through an in dwelling gastric tube

X-ray Examination—In two cases x ray (Figs 153 and 154) revealed a communication between the colon and jejunum rather than

between the stomach and colon. In one case no fistula could be seen on x ray. In all the others the barium entered the stomach promptly when given by enema. In one case a jejunal penetration was diagnosed. In the others there was no mention of a separate jejunal ulcer. However, the jejunum bordering on the anastomosis was irritable and irregular.



Fig 154—Shows large opening between colon and stomach with stomach completely outlined following barium enema.

Pathology.—As already stated, the lesion is one that started primarily as a marginal or jejunal ulcer and subsequently penetrated the colonic wall to produce a fistula. The adjacent mesentery of the anastomotic loop, the mesocolon or the root of the mesentery, singly or in combination, may be involved in an intense inflammatory process. These structures are thickened, friable and edematous. When this inflammatory reaction is especially intense a fresh, fibrinous exudate

may be seen on the mesocolon or mesentery of the jejunal loop. The mesenteries may be shrunken as the result of much cicatrization. Not infrequently this combined pathological involvement gives rise to a large inflammatory tumefaction, consisting of colon and jejunum with their accompanying mesenteries. In some of our cases the mass was



Fig. 155—Reveals simultaneous visualization of stomach and upper jejunum when barium was introduced into the colon by rectum

fist sized. Numerous adhesions of the omentum to the abdominal wall and of the stomach to the under surface of the liver are present. The original duodenal ulcer is cicatrized and healed unless the gastroenterostomy has ceased to function. Ginzburg and Mage⁴ drew attention to the fact that only in a few instances does a gastroenterostomy fail to bring about healing of a duodenal ulcer.

TREATMENT

Prophylaxis.—Before discussing therapy in gastrojejunocolic fistula, emphasis should be directed to its prevention. It has been aptly stated that recurrent ulcer in or about the stoma is "man made." We believe that the operation of choice for duodenal ulcer is gastrectomy with resection well above the reentrant angle of the stomach and beyond the pylorus in an effort to produce an anacidity. We believe that an anterior anastomosis will circumvent the possibility of a colonic fistula should an anastomotic ulcer supervene in a small percentage of patients who still secrete acid. A recurrent ulcer without intimate relationship to the mesocolon is technically much easier to deal with. An occasional gastroenterostomy will have to be done in the old, poor risk patient. The opening in the transverse mesocolon should be made as far away from the colon as the anatomical pattern of this structure will permit.

Preoperative Preparation.—In no group of patients is intensive preoperative preparation more necessary and important for a successful outcome. The metabolic disturbances attendant upon obstruction, dehydration, avitaminosis and anemia have been recounted. The loss of gastric secretion through the fistula results in various degrees of alkalosis and hypochloremia. Guides to adequate preparation are furnished by repeated observations of the blood urea, blood chlorides, serum proteins and the carbon dioxide combining power of the blood. The estimated loss of approximately six liters of fluids excreted normally in the upper intestinal tract and reabsorbed in the ileum and colon but which in the presence of a gastrocolic fistula is "side tracked," emphasizes the preoperative preparation problem.

Anemia should be rectified by repeated transfusions until the hemoglobin level has been raised to within normal limits. We have found that hemoglobin values should be verified constantly inasmuch as the effects of transfusions are transitory until well in the postoperative period. Inasmuch as absorption from the gastrointestinal tract is interfered with, vitamins must be administered hypodermically in an effort to correct the deficiency. Thiamine chloride (0.65 gm.) and 100 mg. of nicotinic acid are administered daily along with large doses of ascorbic acid. Plasma proteins are supplied in the form of parenterally administered hydrolysed casein (amigen). The importance of a low plasma protein level particularly as this disturbance affects tissue edema and gastric emptying time has been stressed by Ravdin⁵ and his coworkers. Plasma infusions are used in addition to the amino-acids to raise the depleted blood proteins. To supply the

depleted blood chlorides 1500 cc. of physiological salt solution is administered daily along with a similar amount of 5 per cent glucose in distilled water. The amount of sodium chloride excreted daily in the urine is a good index of chloride balance. It has been substantiated that a urinary excretion of 3 gm. of sodium chloride is consistent with a positive chloride balance. Coller⁸ has recommended that for each 100 mg. per 100 cc. the plasma chlorides need to be raised in order to reach the normal 560 mg. per 100 cc., the patient should be given 0.5 gm. of sodium chloride per kg. of body weight.

Every effort should be made to rid the stomach of its foul, retained secretions. This is best accomplished by repeated gastric lavages followed by the use of the indwelling gastric tube through which nourishment and antacid medication may be introduced by the continuous drip method. Since the advent of the nonabsorbable sulfas (sulfasuxidine and sulfathaladine) we have been administering them in an effort to reduce the bacterial content of the colon. Every effort should be made to diminish the frequent, watery bowel movements. Bismuth compounds and opium have been used for this purpose. When the blood calcium level is low, should be employed. We have found that for adequate preparation for operation is essential.

by Lemmon⁷ has been used in most of our cases. Relaxation and smoothness of respiratory movement is of paramount necessity. The anesthesia is by nature of the operation a lengthy one and the introduction of the anesthetic agent as required in various phases of the operation, as for duodenal closure and high gastric section, where relaxation is particularly required facilitates and expedites the operative procedure. More recently we have used intratracheal anesthesia with curare. Either method expertly administered will prove satisfactory. Supportive therapy throughout the course of the operation in the form of a continuous intravenous drip supplemented by blood transfusions as blood pressure determinations indicate is essential to counteract shock and loss of blood.

CHOICE OF OPERATION—The indication for operative treatment in gastrojejunocolic fistula is absolute. The prime consideration is to abolish the fistulous connection with the colon. Theoretically operation should entail disconnection and restoration of the structures involved in the fistulous communication (stomach, colon and jejunum).

While gastric resection is ordinarily desirable at the time of the operation for the repair of the fistula it is not always feasible or safe (Fig 156) The marked inflammatory induration and inflammatory exudate surrounding the colon and jejunum does not always permit of safe separation and suture of these structures Postoperative peritonitis, due to peritoneal contamination at the time of operation but more frequently due to the insecurity of sutures placed in indurated tissues with subsequent leakage, was the main factor in a high operative mortality Before recognition of these factors Pfeiffer⁸ quotes operative mortalities ranging between 25 and 63 per cent Procedures

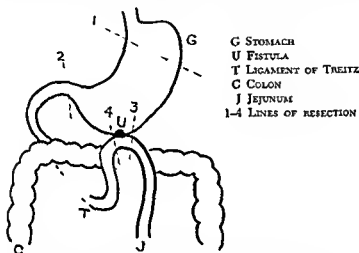


Fig 156—Diagrammatic representation of the theoretical lines of resection in a one stage operation for gastrojejunal fistula

to reduce this mortality were proposed by Schrimmer⁹ who advocated leaving the jejunal ulceration even though the colon were involved resecting the stomach except for a cuff around the old stoma from which the mucous membrane was removed and the muscularis and peritoneal coats approximated Allen¹⁰ suggested an aseptic method of restoring normal stomach and intestinal continuity Division of the stomach above the inflammatory tumor with performance of an anterior gastroenterostomy using a loop of jejunum distal to the previous anastomosis was suggested as a means of "short circuiting" the fistula Preliminary jejunostomy as a means of restoring fluid balance and placing the lesion at rest has been favored by some We have not adopted this procedure in cases of gastrojejunal fistula although

Colp and Druckerman¹¹ have emphasized its value and have employed it as part of the operative procedure

In the main operative procedures as at present employed are limited to

1 *Resection of the fistulous tract with restoration of normal gastrointestinal continuity* This procedure is advocated where the inflammatory process is extensive and it is deemed unwise to prolong the operation by adding a gastric resection. It can only be employed if the pylorus is patent. It has been done in two cases in this series. One patient was exceedingly obese and it was felt unwise to subject the patient to the added risk of resection. It was realized that the duodenal ulcer would become reactivated. This was actually the case and the patient returned one year later with pyloric obstruction. A successful resection was then carried out. The other patient was a 69 year old man in exceedingly poor condition.

2 *Resection of stomach and fistulous tract* Whenever feasible this is the procedure of choice and it was carried out successfully in five patients.

3 *Stage operations* Pfeiffer⁸ and Kent first advocated a diversionary colostomy in the ascending colon. We have employed this method in three cases—two in combination with procedure No. 2—with gratifying results. In both cases there was marked improvement following the colostomy. In one patient belching of foul gas stopped, there was a significant gain in weight, and at operation for the cure of the fistula three months later the fistula was found spontaneously closed. Lahey¹² and Marshall also recommend that the operation be done in stages. The first procedure is division of the terminal ileum with performance of an ileosigmoidostomy. At the second operation the entire colon is resected beyond the fistula along with the stomach. The jejunum is dealt with as indicated. We have not used this procedure in any of our cases. We have not felt that preliminary cecostomy would be sufficiently diversionary if a staged procedure were planned nor have we added it in those cases in which a single operative procedure was used.

OPERATIVE TECHNIC—The abdomen is opened through a midline incision extending from the ensiform to the umbilicus. Where the x ray shows a fistula far to the left (near the splenic flexure of the colon) a transverse incision in the left upper portion of the abdomen is recommended. Adhesions of the omentum to the anterior abdominal wall are divided and the stomach is separated from the under surface of the liver. The stomach and colon are lifted out of the abdomen and

the extent and intensity of the inflammatory and indurated mass appraised. It is best to have a preconceived plan of procedure and the one that has served us best is proceeded with as follows. The finger bluntly penetrates the gastrohepatic ligament along the lesser curvature of the stomach thereby effecting an entry into the lesser peritoneal cavity behind the stomach above the site of the previous gastroenterostomy. This procedure will delineate a free area between the colon and the greater curvature of the stomach (gastrocolic ligament). This ligament is bluntly separated and ligated. It would perhaps be easier to divide the stomach proximal to the lesion at this stage and turning it to the right, to develop the structures entering the anastomosis with the posterior aspect completely in view, but this would entail the addition of gastrectomy before it is completely established whether such an extensive procedure should be done at one time.

After the gastrocolic ligament is divided the upper leaf of the mesocolon is separated from the stomach with great care exercised for the preservation of the middle colic artery. Dissecting above and below the colon a finger can usually effect an entry into the mesocolon surrounding the site of anastomosis which is separated as completely as possible before the site of fistulous communication is entered. Once the colon is entered the opening is dealt with immediately to avoid contamination of the operative field. A clamp is placed above the stoma before the jejunum is cut away to prevent spillage of gastric contents and the jejunal loops identified and mobilized preparatory to reconstruction. If done in one stage a typical gastric resection is added. The duodenum will usually be found to be the seat of scar tissue as the result of a healed lesion. The opening in the mesocolon is closed and an anterior end to side gastrojejunostomy (Hofmeister) completes the procedure. A jejunal loop distal to the site of jejunal reconstruction is selected. This loop should be as short as the anatomical situation permits. A complementary jejunostomy of the Witzel or Kader type which is brought out through a small stab wound is added when it is feared that postoperative atony may ensue.

Management of the Jejunum—Reconstruction of the jejunum (Fig 157) may be simple or extremely complicated and difficult. Where the ulcer is truly marginal and not much of the jejunal wall is involved, a simple closure of the jejunal opening in two layers can be readily effected. In the presence of a short afferent loop with a deep penetration or perforation into the root of the mesentery close to the fossa of Treitz jejunal reconstruction offers a difficult problem. The

lesion here is jejunal rather than marginal and the tissue indurated and friability extreme. End to end suture is hazardous. It is necessary to mobilize the third portion of duodenum and effect closure of jejunum after transferring it behind the mesentery of small bowel. After closing the distal jejunum a relatively safe side to side duodenojejunosomy is then performed. Where the affected



I PURSE STRING CLOSURE



II TRANSVERSE LINEAR SUTURE



III END-TO-END ANASTOMOSIS



IV SIDE-TO-SIDE ANASTOMOSIS



V DUODENOJEJUNOSTOMY

Fig. 157—Some of the methods of jejunal repair used in this series of cases. If the jejunum is of sufficient length an end to end or end to side anastomosis is desirable. In performing an end to end or plastic reconstruction of the jejunum it is essential that there be no encroachment upon the lumen of the jejunum, particularly when gastrectomy is performed, as we have seen leakage from the duodenal stump as the result of back pressure when the jejunum is not properly secured. In the case of a jejunal resection with end to end anastomosis

mosis was performed four times, end to side jejunojunostomy once and plastic reconstruction twice

Management of Colon (Fig 158) —The opening in the colon is usually surrounded by inflammatory tissue which is excised to permit introduction of sutures in relatively normal tissue. As a rule, the opening can be simply closed in a transverse direction using interrupted



I SMALL DEFECT



PURSE STRING CLOSURE



II LINEAR DEFECT



TRANSVERSE SUTURE



III LARGE DEFECT



OBSTRUCTIVE RESECTION

Fig 158.—Methods of repair of colonic defect as used in this series of cases

sutures without compromise of the bowel lumen. In one case the lesion was so large as to require a resection of the involved bowel. In this case no immediate anastomosis was carried out. The two limbs of colon were exteriorized.

Postoperative Therapy.—The indwelling gastric tube is connected to a suction apparatus and is removed at the end of forty-eight hours

After this, the tube is passed at night to insure against gastric retention. When jejunostomy is done a continuous drip of a specially prepared aliment is introduced by the drip method. Fluid balance is assured by a continuous intravenous drip and plasma and whole blood are supplied as required. Efforts are made to get the patient out of bed early to insure adequate diaphragmatic excursions. Excessive bronchial secretions are bronchoscopically aspirated and the patient is encouraged to expectorate. We have used penicillin pre- and post-operatively and feel it has reduced the incidence and severity of postoperative pulmonary complications.

SUMMARY AND CONCLUSIONS

Our experiences with the management of gastrojejunocolic fistulas have been reviewed. Whereas ideally, operation should aim to excise the fistula and reconstruct the parts along with gastrectomy, each case must be evaluated individually. In some, the general condition of the patient will contraindicate so lengthy a procedure. In others, the local condition because of its size and infectious potentiality will warrant a staged procedure. Eight cases are recapitulated. In some the operation was completed in one stage. In others, ascending colostomy was done as a preliminary procedure. There was one death.

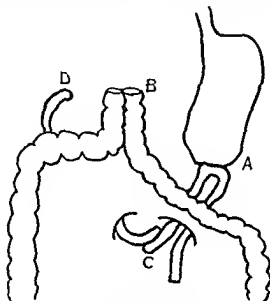
Gastrojejunocolic fistula is a life threatening complication of gastroenterostomy. As opposed to gastrojejunal ulcer which may respond to medical management the operative indication in the former is absolute. The technical procedure is difficult and time consuming. The operative mortality which was formerly extremely high can be kept low by adequate preoperative preparation and the selection of a staged procedure. Gastrectomy should be part of the operative procedure whenever feasible.

BRIEF RESUME OF ILLUSTRATIVE CASES

Case I Large Gastrojejunocolic Fistula Necessitating Resection of Transverse Colon Staged Procedure. H. S. a man aged 39 entered Mount Sinai Hospital with a history of nocturnal diarrhea, loss of 20 pounds in weight and belching of foul gas for a period of a year and a half. Two years ago in another hospital a gastroenterostomy was performed for a duodenal ulcer. Three months

after the patient said that he was relieved of the malodorous gas. One month later laparotomy was performed. At operation an enormous jejunocolic fistula was

disconnected necessitating end to-end suture of the jejunum and because of the large colon defect with surrounding induration a resection of the transverse colon (Fig 159) Immediate end to end suture was thought inadvisable and both loops were brought into the wound as a temporary colostomy with the formation of a spur Partial gastrectomy was carried out followed by a posterior end to end gastrojejunostomy (Hofmeister) A posterior anastomosis was necessitated because of the temporary colostomy Pathological examination revealed the resected stomach, jejunum and colon with a large indurated colonic fistula The patient recov



A GASTROJEJUNOSTOMY
B OBSTRUCTIVE RESECTION
C JEJUNOJEJUNOSTOMY
D DUODENAL CLOSURE

Fig 159—Diagrammatic representation of the type of repair and gastrectomy performed in this case

ered from this procedure uneventfully and both spurs were subsequently crushed and the colostomies closed without incident.

Case II Gastrojejunocolic Fistula with Restoration of Gastrointestinal Continuity Following Ascending Colostomy. Subsequent Gastrectomy for Re-activation of the Duodenal Ulcer—A B., a man aged 57, had a gastroenterostomy performed for a duodenal ulcer twenty five years prior to admission. Nine months prior to admission the patient had watery stools, fecal eructations, anorexia and a weight loss of 40 pounds. Methylene blue enema was recovered from the stomach promptly. X-ray showed a gastrocolic and jejunocolic fistula. There was a marked hypoproteinemia. A preliminary ascending colostomy was per-

formed. This procedure did not seem to influence or better the patient's general condition. Subsequent operation revealed the fistulas still active. Because of the patient's poor general condition, the fistulous openings were disconnected, the jejunum, colon and stomach openings closed. A Witzel jejunostomy was added for feeding purposes. The duodenal ulcer was inactive. One year later the patient was readmitted with pain and evidences of pyloric obstruction. At this time a partial resection of the stomach with anterior end-to-side gastrojejunostomy (Hofmeister) for an acute duodenal ulcer was performed. Convalescence was uneventful. The patient was discharged and has remained well.

Case III. One-Stage Operation for Gastrojejunocolic Fistula—L. E. a man aged 52, had a posterior gastroenterostomy performed thirty years ago for a duodenal ulcer. During this interval the patient had intermittent attacks of ulcer pain. For two years prior to admission there was an intractable diarrhea. Physical examination revealed marked weight loss and foul breath. Methylene blue introduced into the rectum was recovered from the stomach promptly. X rays showed the column of barium to enter the stomach and small intestines from an area in the region of the splenic flexure (Fig. 155). The patient was prepared for operation by administration of parenteral fluids and gastric lavage and was given large doses of sulfasuxidine. Operation in one stage consisted in a jejunoplasty, repairs of the colon and a partial gastrectomy with a termo-lateral anterior (Hofmeister) gastrojejunostomy. The patient was discharged well eight days after operation.

Case IV. Ascending Colostomy Followed by Healing of the Colonic Fistula Subsequent Partial Gastrectomy—A man, aged 52 was admitted with a history that three years before he had a gastroenterostomy for a stenosing duodenal ulcer. Three months prior to this admission he began to have frequent bowel movements accompanied by belching of fecal smelling gas. There was a 10 pound loss in weight. Barium enema revealed the presence of a gastrocolic fistula. An ascending colostomy was performed. Almost immediately the patient

Barium by mouth did not enter the colon and barium enema merely showed an irregularity in the midcolon. Operation revealed the colonic fistula healed. Partial gastrectomy and jejunectomy with anterior gastroenterostomy (Hofmeister) were performed. The colostomy was subsequently closed. The patient made a smooth recovery. He has remained well with a 25 pound weight gain.

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PROXIMAL EXTENSION AND PROGRESSION FOLLOWING OPERATIONS FOR REGIONAL ILEITIS

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PROXIMAL extension, progression or recurrence of disease following surgical therapy in regional ileitis is not rare. This may occur either after ileocolic resection in which the diseased ileum is removed, or following ileocolostomy with ileal division in which the involved bowel is simply excluded. Clinical experience has proved that many of the recurrent symptoms following ileocolostomy with exclusion for regional ileitis are due to an extension or progression of the disease in the proximal ileum rather than the persistence of the disease in the excluded bowel. For, in many of the secondary explorations, in which the sidetracked ileum was inspected, the lesions in the bowel and mesentery had healed unless ileostigmoidal fistulas were present.

As a matter of fact, while fibroplasia is seen generally in the early stages of the disease, followed later by fibrostenosis in the untreated cases, there seems to be a greater tendency for these intestinal and mesenteric lesions spontaneously to regress following exclusion. There is little likelihood, then, that the disease in the terminal ileum remains sufficiently active in most cases to act as a focus for extension along the mesenteric lymphatics to the proximal ileum. What is even more significant is the greater incidence of proximal recurrence in those cases in which the diseased terminal ileum has been resected. The mechanism of proximal recurrence following either ileocecal resection or ileocolostomy with exclusion appears similar. It is most probable that the loop of bowel selected for the anastomosis to the colon harbored small mucosal or submucosal lesions which escaped detection. Therefore, these so-called skip areas were not completely excluded and a recurrence was present in the proximal ileum at the time of enterocolostomy. There may be occasional exceptions to this, namely in those cases in which the proximal ileal extension occurred several years after ileocecal resection. Here, the possibility exists that the unknown agent which caused the original disease may again have become instrumental in the production of the proximal ileal recurrence.

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The symptoms which were noted in these cases are similar to those which characterize the original lesion. Fever of varying intensity and duration was present. Cramps and dyschezia were noted. The stools became loose in consistency and increased in number. Coincidentally signs of intermittent intestinal obstruction were occasionally observed, accompanied by abdominal distention, nausea and vomiting. Anorexia, loss of weight and strength became apparent and with it the appearance of definite anemia.

Physical examination often revealed a distended abdomen and occasionally a tender mass was present in the region of the ileocolostomy. Roentgenograms with the aid of oral barium invariably pictured a narrowing of the bowel proximal to the anastomosis, occasionally so marked that a characteristic string sign was produced. In some instances the strictured areas alternated with dilated loops of intestine and rarely a partial stenosis of the ileocolic stoma was seen. Inasmuch as very little seemed to be gained by conservative medical treatment in these cases in which active symptoms, physical signs and positive ray findings were present, operation was decided upon. Antepoperatively these patients were prepared by a high protein diet and the necessary vitamins especially the B complex reinforced by the parenteral administration of glucose, saline, whole blood, plasma and molog. A course of sulfasuxidine or sulfathiazidine was prescribed. The use of the Miller Abbott tube was considered to be of paramount importance and every effort was made to insure its successful introduction. It not only decompressed the small bowel but the tip of the tube was of infinite value in differentiating the distal from the proximal bowel. With the exception of

a strictured small bowel intimately adherent and densely attached to the surrounding viscera. Postoperatively the Miller Abbott tube maintained intestinal decompression.

Spinal anesthesia was used almost routinely. The abdomen was explored through a mid left rectus muscle splitting incision. Upon opening the peritoneal cavity the tip of the Miller Abbott tube was immediately sought for its location was a guide for the proximal level. Once orientation had been secured and the local lesion had been thoroughly inspected the question of surgical procedure arose. Since we have never been convinced of the advantage of ileocecectomy for terminal ileitis except in selected cases we are similarly poised, in recurrences to resection of the diseased proximal ileum,

except when an ileosigmoidostomy had been performed. In a previous communication we stated our preference for ileotransverse colostomy rather than ileosigmoidostomy with exclusion in operations for terminal ileitis. This was advised because if an extension or recurrence took place, proximal to the transverse colostomy, the diseased bowel could again be excluded by a second ileal division, approximately 60 cm proximal to the last visible evidence of disease, provided that sufficient small intestine remained to insure adequate nutrition. Ileocolic continuity could be restored by an ileosigmoidostomy. This method offers a solution for a serious condition in which radical surgery may be extremely hazardous. It may be technically difficult to separate the diseased ileum from the transverse colon and its adhesions to surrounding parts prior to resection. Ileal division with a side to side isoperistaltic ileosigmoidostomy eliminates most of these difficulties.

Following this operation the abdomen was closed without drainage, using continuous chromic catgut for peritoneum, interrupted wire for fascia, pincettes and silk for the skin. Small amounts of fluid were allowed by mouth almost immediately, but parenteral therapy was continued until the Miller Abbott tube was removed. This was usually withdrawn on the fourth or fifth day, or before, provided the abdomen was soft and not distended. All patients experienced a smooth and uneventful postoperative course. The period of convalescence was not marked by any unusual complication. In the beginning, bowel movements were fairly frequent, but gradually two or three soft movements resulted.

Many of the theoretic objections voiced against primary enterocolostomy with exclusion in regional ileitis as the cause of immediate and late postoperative complications have never materialized. The distally divided ileum has never blown out because of an obstruction in the diseased bowel for following the diversion of the fecal current the inflammatory process subsided sufficiently to permit the free flow of intestinal secretions into the large bowel. Moreover, the possibility that the blind ascending and proximal parts of the transverse colon may become distended and filled with scybala has never been observed. The fear that the implantation of the proximal ileum into the sigmoid might lead to a persistent diarrhea has never been substantiated. In fact, previous studies have noted no difference in bowel function following either ileotransverse colostomy or ileosigmoidostomy. It has been demonstrated that the contents of the small bowel upon entering the colon first pass in a retrograde direction for a dis-

tance evidently sufficient to allow the absorptive phenomena of the colon to take place. This results in a semisolid or solid stool.

In a small series of cases, and with a limited period of follow up observations, to date no definite conclusions as to the ultimate efficacy of this procedure can be drawn. It may be stated, however, that no symptoms have developed which possibly could be attributed to the presence of the isolated ileal loop attached to the transverse colon. In one patient who succumbed three years after a secondary ileosigmoidostomy with ileal division following a primary ileotransverse colostomy with ileal division for regional ileitis, postmortem study revealed that the excluded bowel 27 cm. in extent draining into the transverse colon had healed grossly and that the ileosigmoidostomy appeared normal. This finding, and others previously discussed, seem to indicate that healing in ileitis invariably occurs following exclusion, be it the terminal ileum or the proximal ileum in which extension, progression or recurrence of the disease has taken place.

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MUCOCELE AND MYXOGLOBULOSIS OF THE APPENDIX

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WHEN the peritoneal cavity is invaded in search of an inflamed appendix, the surgeon is not at all unlikely to find a variety of unexpected situations. It is axiomatic that he should be familiar with the possibilities and technically equipped to deal with the problems presented. A partial list of the diverse conditions encountered includes adjacent pathological structures as diseases of the fallopian tubes and ovaries, cecal neoplasms, diverticula and carcinoma of the ascending colon, carcinoma and carcinoid of the appendix, mucocoele of the appendix, and more remote lesions as gallbladder inflammation, ruptured peptic ulcer and the like. The following cases are presented to illustrate the problems encountered in the management of mucocoele of the appendix.

Mucocoele of the appendix has been referred to variously in the literature as cystic disease, hydrops, retention cyst and colloid cyst. These descriptive terms originate from the appearance of the organ, which is found distended by an accumulation of jelly like material within the lumen.

Myxoglobulosis refers to the variety of mucocoele in which small globular bodies of condensed mucoid material are found embedded in the main mass. It is not known how or why the condensation takes place. Possibly mild infection occurs with sufficient change in the pH to alter the colloidal state of some of the protein material.

Mucocoele is an unusual and unexpected finding at operation. At the Cook County Hospital from January, 1929 to January, 1937, 9180 postmortem examinations were made. Only four instances of mucocoele of the appendix were encountered. From July, 1928 to January, 1937, 9535 appendices were removed at operation, twenty-two were mucocoeles.¹

On rare occasions the distended organ ruptures or leaks and the gelatinous material becomes implanted in the peritoneal cavity where large masses may be formed. In one instance the entire greater omentum of an elderly man had become converted into one large, partially

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tance evidently sufficient to allow the absorptive phenomena of the colon to take place. This results in a semisolid or solid stool.

In a small series of cases, and with a limited period of follow up observations, to date no definite conclusions as to the ultimate efficacy of this procedure can be drawn. It may be stated, however, that no symptoms have developed which possibly could be attributed to the presence of the isolated ileal loop attached to the transverse colon. In one patient who succumbed three years after a secondary ileosigmoidostomy with ileal division following a primary ileotransverse colostomy with ileal division for regional ileitis, postmortem study revealed that the excluded bowel 27 cm. in extent draining into the transverse colon had healed grossly and that the ileosigmoidostomy appeared normal. This finding, and others previously discussed, seem to indicate that healing in ileitis invariably occurs following exclusion, be it the terminal ileum or the proximal ileum in which extension, progression or recurrence of the disease has taken place.

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quadrant mass, reexploration was eventually done at the Mount Sinai Hospital disclosing mucocoele of the appendix. Here the appendix had undoubtedly been the seat of severe infection. Very likely it had perforated and emptied into the abscess which was drained at the first operation. Having discharged its purulent contents the intrinsic infection subsided. The trauma was sufficient however to seal off the proximal end with the production of a mucocoele.

In the Cook County series¹ the ages of the patients varied from 1 to 70 years and were relatively evenly distributed. There were seven males and nine females.

There is no characteristic clinical feature which makes it possible to recognize this condition preoperatively. Symptoms which bring the patient under observation are usually suggestive of a mild or recurrent attack of appendicitis. The patient may have some fever and the white blood count may or may not be elevated. Abdominal signs are usually minimal and not often characteristic of marked peritoneal irritation. In a few of the case reports a mass was said to be palpable through the abdominal wall in the right lower quadrant in the region of the cecum. In several instances an extrinsic filling defect of the cecum was noted on x-ray examination with barium enema.

Ordinarily the mucocoele is found in the course of an exploratory laparotomy performed for an obscure syndrome of vague recurrent abdominal pain centered in the right lower quadrant with or without an associated right lower quadrant mass. In the past twenty five years there have been seven cases of mucocoele of the appendix recorded at the Mount Sinai Hospital. One of these cases was operated on by Dr. Samuel Mufson and is included in this report through his kindness.

CASE REPORTS

CASE 1—The patient was admitted September 18, 1941 and discharged October 11, 1941. He was a 42 year old man who first had an abdominal exploration in another city because of preoperative diagnosis of appendicitis. On opening the abdomen the surgeon found "a mass of mucoid jelly like material occupying the neighborhood of the appendix and a hard mass in the retroperitoneal tissues continuous with the appendix and cecum. The liver was free as was the terminal ileum." The impression gained was that mucoid carcinoma of the bowel was present. Since there was no obstruction and since the condition seemed inoperable the abdomen was closed and the man considered doomed.

The patient continued to have vague intermittent right lower quadrant pain without vomiting. His bowels moved normally. He had no weight loss.

Five months later he came under the care of Dr. Mufson because of his abdominal complaints. At that time his hemoglobin was 96 per cent and white blood count 7,350 with 70 per cent polymorphonuclears. The stool was negative

calcified, myxomatous mass.² In another case, presented below, the surgeon encountered a mass of mucoid material overlying the cecum. He thought he was dealing with an inoperable mucous carcinoma of the bowel and closed the abdominal incision. Subsequently, a second operator removed a retrocecal, retroperitoneal mucocele of the appendix which was the source of the jelly like material. The patient made a complete recovery.

This latter condition of disseminated, intraperitoneal mucus is one variety of an ill defined, rare entity called pseudomyxoma peritonei. Mucous cell carcinoma of the gastrointestinal tract and of the ovary are two other points of origin of intraperitoneal mucus.

At least three conditions are necessary for the formation of a mucocele of the appendix, namely, stenosis of the lumen at the cecal end, continuous production of mucus, and absence of persistent violent infection. When rapid mechanical obstruction of the appendiceal lumen occurs as by a fecalith, appendiceal colic with its resultant symptomatology is experienced and may lead to early operation before a mucocele can be formed. Usually infection is superimposed and the closed off lumen constitutes an excellent culture tube for the colon organisms. Empyema of the appendix results with its characteristic train of events. If the stenosis however is slow, and the rate of mucus formation such that organisms are washed out, as it were before the final sealing off, distention may proceed, limited only by the rate of absorption and the rate of production of mucus. As the intraluminal pressure increases the walls of the organ become thinned out and eventually the activity of the mucous membrane ceases. As this process goes on the appendix becomes distorted assuming a variety of shapes and sizes—hour glass, cylindrical and elongated forms. While distending the appendix may invaginate into the cecum to some degree thus causing considerable confusion with granuloma or other cecal tumor. This occurred in two of the cases reported below and has been noted in several cases reported in the literature. A portion of the cecal wall must be resected in order to remove the mucocele.

In one case included here acute appendicitis with the formation of an appendiceal abscess had occurred in a 13 year old boy. At operation elsewhere the abscess was drained. Subsequently another intraperitoneal abscess developed and again drainage was performed. This time a structure believed to be the appendix was removed but on closer examination and histological study turned out to be inflamed adipose tissue. Because of the presence of a palpable right lower

in the gross *Diagnosis* Chronic productive and exudative obliterating appendicitis Mucocoele at tip with myxoglobulosis

Exploration of this man's abdomen was done for subacute appendicitis. Discovery of the mucocoele was, of course, unexpected.

It is interesting that there was no evidence microscopically of chronic infection in the wall of the appendix. The degree of infection was evidently sufficient to cause a physicochemical change in the mucus with the formation of small white globules characteristic of myxoglobulosis.

The patient recovered uneventfully and has remained well.

CASE III—Mrs. C. K. was admitted August 5, 1945 and discharged August 28, 1945. This 48-year-old married woman had an eight-month history of epigastric distress coming on at irregular intervals and not related to ingestion or type of food. Two weeks before admission she began to have pain in her right lower quadrant which was relatively constant. She had no bowel symptoms and there had been a general weight loss during the past year due to dieting. Past history was essentially noncontributory. Physical examination revealed a well-nourished afebrile woman. There was a small mass in the right thyroid lobe. Examination was otherwise normal except for a firm, tender, movable mass in the right lower quadrant. The hemoglobin was 93 per cent, white blood count 8900 with a normal differential count. The urine was normal. At operation on August 8, 1945, the abdomen was opened through a right rectus muscle splitting incision. In the region of the appendix was a dumb-bell shaped mass which invaginated into the cecum. The mass measured roughly 3 by 8 cm. The mass could not be skinned out of the cecum; therefore it was removed together with a portion of the adherent cecal wall. The defect in the cecum was then closed by means of running Connell sutures of atraumatic chromic catgut and a serosa suture of chromic catgut. Since the cecum had been opened the peritoneum was closed but the remainder of the wound was left open because of possible contamination. It was packed lightly with iodoform gauze and the skin edges were strapped across.

The pathological report follows: *Gross* A cystic structure elongated, 3 cm in diameter and 8 cm long. It is filled with very tenacious turbid mucinous material. The inner lining is white mucosa and the wall is a few millimeters thick. *Grossly* it is benign. *Microscopic* The wall has bundles of smooth muscle indicating canal origin. The lining is columnar epithelium, much of it destroyed by chronic inflammation and covered with mucus. There is no indication of malignancy. *Diagnosis* Mucocoele of the appendix.

The case is striking in that a mass was palpable in the right lower quadrant preoperatively. It was for this reason that exploration was carried out. Of interest too is the fact that removal of the appendix necessitated resection of a portion of the cecal wall. Convalescence was satisfactory and uncomplicated.

CASE IV—This 37-year-old married woman was admitted November 2, 1944 and discharged November 22, 1944. She had had metrorrhagia for about seven

for occult blood. Abdominal examination revealed a mass in the right lower quadrant about the size of a fist. This mass was fixed. Rectal examination was negative. A barium enema showed no intrinsic lesion of the large bowel, but the cecum was displaced anteriorly and to the left.

On exploration the omentum was found adherent in the right gutter. There was a large amount of jelly like material in the iliac fossa overlying the cecum, and in the pelvis. Behind the cecum a retroperitoneal mass was found which proved to be the appendix. There was a perforation near the base from which the jelly like material was oozing. It was approximately 9 cm. long and 5 cm. in diameter bulbous and filled with mucoid material. The postoperative course was uneventful and five years later the patient was well and had no significant complaints.

This case is of particular interest not only because a mucocoele was discovered but also because it is a rare instance of pseudomyxoma peritonei of proved appendiceal origin.

CASE II—Dr. L. K. was admitted May 28, 1945 and discharged June 10, 1945.

This 33 year old dentist began to have vague abdominal pain one week before admission. Three days later pain localized in the right lower quadrant and was associated with nausea. Three days before admission his temperature rose to 102° F and the next day to 103° F. The temperature subsided so that on the day before admission it was normal. He had no urinary symptoms, no constipation and no abnormal stools. There were no previous illnesses or operations.

On examination the temperature was 99° F, the pulse 84. There were no abnormal findings except for the abdomen where slight tenderness was present on deep palpation over McBurney's point. Rectal examination was negative. No masses were felt. Blood study revealed a hemoglobin of 86 per cent, white blood count 16,500 with 68 per cent segmented polymorphonuclears, 4 per cent eosinophils, 5 per cent large lymphocytes and 2 per cent monocytes. The urine was normal. On June 1, 1945 the abdomen was opened through a right hammanet incision. The appendix was about 3 inches in length and $\frac{3}{8}$ inch in diameter and was found buried retroceally. Its walls were thickened. Appendectomy was performed using chromic ligature for the base and amputating distal to the tie with carbolyzed knife. The denuded retrocecal space was drained by a single small rubber drain and the wound was packed open down to the peritoneum with iodoform gauze.

The pathological report follows: *Gross*—A 5 cm long appendix 1.5 cm in diameter shiny on the outer side. The wall is thick and fibrous and practically occludes the lumen. At the tip there is a mucocoele 1.5 cm in diameter containing besides some mucus small white globules. *Microscopic*—There is a mucocoele at the tip and above it the wall is greatly thickened by fibrous tissue and its lumen is occluded. A marked chronic inflammatory cellular exudate exists on the outer surface of the appendix. In the wall of the mucocoele there is also a marked chronic cellular exudate. No definite epithelial lining is seen. In a portion of the wall there is mucus in which lie small round bodies composed of seminecrotic round cells held together by mucus. These correspond to the white globules seen

CASE V—This patient was admitted March 23 1946 and discharged April 16, 1946. He was referred to the hospital and operated upon by Dr. Leonard Drucker, man service of Dr. Ralph Colp.

This 13 year old white boy had had an episode of right lower quadrant pain, nausea, vomiting and diarrhea. He was hospitalized elsewhere and an appendiceal abscess was drained. Eight months later an intraperitoneal right lower quadrant abscess reappeared and was again drained. This time a stricture thought to be the appendix was removed. Histological examination disclosed inflamed adipose tissue.

The patient was referred to the hospital because of the presence of a firm right lower quadrant mass.

Physical examination revealed a well nourished, well developed boy with two McBurney, one midline and one right inguinal scar. A tubular firm mass was palpable beneath McBurney's point. The hemoglobin was 83 per cent and the white blood count 14,900. The stool was negative for occult blood. X-ray examination with barium enema showed a deformity of the caecum, thought to be due to adhesions or an extensive mass. The terminal ileum was not visualized.

At operation a cystic mass measuring 3 inches by 1½ inches was encountered and removed. It proved to be a mucocoele of the appendix.

Convalescence was uncomplicated and patient was well when seen on September 18, 1948.

This case is of interest for several reasons. First, it illustrates the production of a mucocoele from a perforated "burned out" appendicitis. Secondly, its main manifestation was a palpable abdominal mass. Lastly, barium enema revealed an extrinsic distortion of the cecum.

SUMMARY

1. Mucocoele and myxoglobulosis of the appendix is a rare condition which may be the origin of pseudomyxoma peritonei.
2. Removal of the mucocoele is sufficient for cure.
3. Removal may entail resection of a portion of the cecum.
4. Five illustrative cases are presented.

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years. Four years previously diagnostic curettage had been done without improvement of her condition. Past history was essentially noncontributory. Examination revealed a well developed, well nourished white woman not acutely ill and afebrile. Examination of the abdomen revealed no masses and no tenderness. The hemoglobin was 77 per cent, white blood count 7900, with a normal differential count. The urine was normal. Pelvic examination revealed a nodular, slightly enlarged uterus. At operation on November 3, 1944 the uterus was seen to be enlarged to the size of a small fist with several small fibroids, one of which was pedunculated. There was a right ovarian cyst. The appendix was as large as an index finger, hard and invaginated into the cecum. Supravaginal hysterectomy and right oophorectomy were performed. The appendix could not be detached from the cecum and accordingly a portion of the cecum with the base of the appendix was removed. The defect in the cecal wall was then closed with two purse-string sutures of silk. The abdomen was closed in layers. The midline abdominal wound was closed in layers and a stab wound drain was placed in the right lower quadrant.

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fibroid in the serosa. Another small piece of membranous tissue looks like part of the wall of an ovarian cyst. A dilated appendix with a thick wall is filled with a considerable quantity of mucinous material in which there are innumerable small, round gray bodies varying from less than 1 mm to 3 mm in diameter. A small

lory connective tissue and some foci of round cells. Large portions of the mucosa are covered with hypertrophied mucous glands otherwise normal. Other large portions of the mucosa have lost the glandular structure show foreign body cells and the remains of a few mucous cells. It appears to be an inflammatory process. In this altered mucosa are seen a few small calcified bodies. In the wall are some small cysts filled with mucus but without an epithelial lining. Some of the white globular bodies were sectioned. They have centers composed of granules of calcified material. Around these centers are numerous concentric rings of amorphous material held together by mucus. They are not ova but were formed in situ. A reference in Aschoff's "Pathology" apparently describes this condition except for the calcium content of these bodies. He calls it "myxoglobulosis" in which the contents of the mucocoele are converged into globular bodies. In this case the wall of the cecum is normal. *Diagnosis:* Fibromyomas of the uterus, glandular hypertrophy of the endometrium, mucocoele of the appendix, myxoglobulosis of the appendix.

This was another case of myxoglobulosis which was sufficiently invaginated into the cecal wall as to require resection of part of it.

EARLY POSTOPERATIVE MOTOR RESPONSE OF THE SMALL INTESTINE TO JEJUNAL FEEDINGS

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The importance of intrajejunal alimentation in surgery of the gastrointestinal tract has long been recognized, and the current literature reveals a renewed interest in this procedure.⁸ A major factor in the increased use of surgical jejunostomy and orojejunal intubation for this purpose is the improvement in the feeding mixtures employed. Such modifications have eliminated in great part, the diarrhea, cramps and other gastrointestinal disturbances associated with the administration of early types of feeding mixture.⁵⁻¹⁰ Experimental evidence as well as clinical observations have shown that tissue healing is influenced in major degree by nutritional status, and also by fluid and electrolyte balance. Hence, it is important, whenever jejunostomy is performed for alimentation, that such feeding be instituted as soon after the operation as physiological considerations permit.

There is considerable evidence that during the first days after abdominal operations, patients suffer some impairment in the threefold activity of the gastrointestinal tract: secretion and digestion, absorption, and motility. However, in jejunostomy patients, it is not known whether the extent of such impairment is great enough to invalidate the use of intrajejunal feeding during this period. In anticipation of deficiencies in secretion and digestion, we previously advocated the use of a predigested synthetic aliment.² It was the purpose of the present study to evaluate the small bowel motility in such patients during the first two days following operation. Data on intestinal absorption are not available at present, but this problem must await later investigation.

MOTOR ACTIVITY OF GASTROINTESTINAL TRACT FOLLOWING JEJUNOSTOMY

In order to study motor activity of the gastrointestinal tract, a series of radiographs were taken, employing only patients with surgical

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contrast material was distributed throughout the jejunum below the fistula. By the second hour the aliment was already in the upper ileum and by the third hour it had reached the lower ileum. The ten hour picture showed most of the contrast material in the ileum and cecum, with some of it in the ascending colon.

CASE II—J L, a man 47 years old, was admitted with a fifteen year history of pyloric ulcer, at exploration (March 9, 1944) the ulcer was found embedded in a huge inflammatory mass extending into the lesser omentum. Because of the technical difficulties which this presented for radical surgery, only a preliminary jejunostomy was performed for alimentation and relief of the inflammation. The patient was maintained on the predigested aliment for two months, during which he gained weight and became symptom free. Subsequently (May 8, 1944) the patient was re-examined and a subtotal gastric resection was performed. Both the ulcer and the inflammatory reaction had diminished considerably, which greatly simplified the technical aspects of the surgical procedure. Radiography was started twenty four hours after operation.

In the one hour picture only a few jejunal coils were visible, but a greater number of loops were outlined after two hours. All of these showed a normal pattern. One hour later the small intestine was uniformly radiopaque. In five hours, the upper jejunum was empty and the contrast material had reached the cecum. The twenty hour radiograph showed contrast material extending from the last ileal coil to the transverse colon.

CASE III—I G, a man 70 years old, was admitted with a short history of nausea and vomiting. The gastrointestinal series disclosed a prepyloric obstructive lesion. Operation (January 2, 1945) revealed the presence of a prepyloric gastric ulcer for which a retrocolic isoperistaltic gastrojejunostomy was performed and a tube jejunostomy established.

The first series of radiographs was taken twenty four hours after operation. In this series the one hour film showed a rather atonic jejunal loop with poor segmentation, the transverse colon and rectum contained some opaque material from a previous barium enema. The two hour picture visualized the lower jejunal loops, but after three hours both jejunum and ileum showed scattered filling. Tonus of the upper loops appeared to be increased. No substantial change was noted after five hours, but after twenty hours only the cecum, ascending and transverse colons were visualized.

The second series twenty seven days after operation, afforded a control on the earlier one. One hour after injection the contrast material was scattered from the level of the jejunostomy down to the upper ileum, with traces in the cecum and ascending colon. It is interesting that the residual stomach was partially filled with contrast material, but the duodenum was not. Two hours after injection, some aliment was still present in the stomach and upper jejunum, but some of it had traveled down as far as the transverse colon.

CASE IV—J B, a man 43 years old, was admitted with a five year history of peptic ulcer, diagnosed by gastrointestinal series. The picture was typical of a duodenal ulcer which had perforated ten days previously. On admission, the epigastrium and right hypogastrium were still tender to the touch, x ray examination confirmed the diagnosis of a perforated prepyloric ulcer. An exploratory operation (June 27, 1946) revealed a recent upper abdominal peritonitis, with thin, friable,

jejunostomy, motility during orojejunal intubation was not investigated. It was our objective to determine whether the massive introduction into the jejunum of 100 cc of aliment (with barium added) distends the bowel unduly, or whether the material is transported aborally at a rate sufficient to permit its routine administration. The radiopaque suspension was prepared from the predigested aliment by replacing the small volume of cream with an equal volume of a sterile mixture of 30 gm of barium sulfate in water. The resulting suspension was stable enough so that only negligible sedimentation occurred within two hours following preparation. In conformity with our routine practice, the mixture was warmed to body temperature and injected over a five minute interval. All subjects were in a fasting condition. However, in the early postoperative studies isotonic saline or glucose or both were given intravenously. In control studies performed three to five weeks after operation, the fasting period was never less than fourteen hours. Radiographs were taken at one, two, three, five to ten and twenty to twenty four hours following injection. In all, five patients were studied in this investigation. Two of these (J B and M M) were studied immediately after preliminary jejunostomy. In two others, jejunostomy was performed simultaneously with major gastric surgery. The fifth patient (J L) was studied only after a gastric resection following a preliminary jejunostomy.

The results are summarized in Tables 1 and 2. One illustrative series of four radiographs is also presented. The clinical histories and a brief description of the observations are as follows:

type was performed. A supplementary tube jejunostomy of the Kader Stamm type was done simultaneously.

The first radiograph for the present study was taken twenty four hours after operation. The one-hour film showed a filling without distention of the injected loop and its adjacent segments. These coils had a normal pattern with well defined segmentation. Neither the duodenum nor stomach contained any contrast material. The two-hour picture showed a wider distribution of radiopaque material, intestinal tonus and segmentation appeared to be somewhat lessened. The five hour picture revealed a more uniform distribution throughout the small bowel, some of the loops displayed spasticity, others relaxation. After twenty four hours all of the contrast material was in the last 2 inches of ileum, cecum and the lower ascending colon.

These studies were repeated twenty days after operation. At one hour the

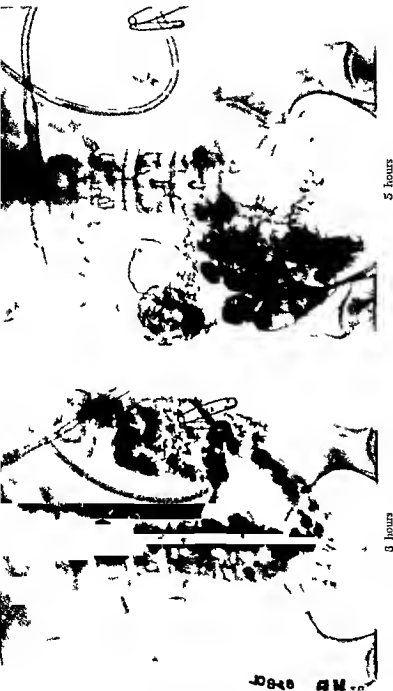


Fig 160—Serial radiographs of the intestinal tract forty hours after operation for preliminary jejunostomy (M M) to show the rate of transport of the pre-digested aliment. The time under each radiograph indicates the number of hours after injection through the jejunostomy tube.





5 hours

3 hours

Fig 160—Serial radiographs of the intestinal tract forty hours after operation for preliminary jejunostomy (M M) to show the rate of transport of the redigested aliment. The time under each radiograph indicates the number of hours after injection through the jejunostomy tube.

residual adhesions between the viscera and the abdominal wall. An ulcer was imbedded in an inflammatory mass near the pylorus. Only a preliminary jejunostomy was performed.

The first x ray series was started one day after operation. Unfortunately the earliest picture was taken five hours after the injection at which time there was no contrast material around the jejunostomy tube. Only a loop of the upper ileum was well defined but some contrast material was scattered throughout the jejunum. The ileum showed poor tonus but definite segmentation. The twenty four hour picture revealed the bulk of the aliment filling the lowermost ileum, cecum and ascending colon.

A second intestinal series was taken thirty five days after operation. One and one half hours after injection the head of the contrast material had reached the ascending colon but there also was extensive scattering throughout the small bowel. By the third hour the jejunum and upper ileum were completely empty and the aliment extended from the lowermost portion of the ileum to the transverse colon. By the sixth hour it had left the small bowel and entered the splenic flexure. In the twenty four hour film the small bowel appeared to be completely empty.

CASE V—M M a woman 70 years old was admitted with a twenty five year history of duodenal ulcer leading to pyloric obstruction. Because of her poor general condition only jejunostomy for alimentation was performed (January 14 1948).

The small bowel was examined forty hours following operation (see illustrative series [Fig 160]). One hour after injection of the barium aliment, the contrast material deeply segmented was present in the lower jejunum and upper ileum. The traces of radiopacity in the transverse colon presumably derived from previous x ray examination. The two hour picture showed a lessening of tonicity and further propulsion of contrast material into the ileum. The three hour picture showed a somewhat wider distribution and after five hours the upper jejunum was empty and the contrast material had advanced into the cecum.

COMMENT

Table 1 contains a summary of results obtained in the present study. On the second day after operation in three of the five patients the jejunum was practically devoid of radiopaque aliment by the fifth hour after injection. By the twenty fourth hour the ileum contained little if any (0 or +) contrast material in four cases and the jejunum was completely empty in the fifth. The aliment first appeared in the cecum in three to five hours in two cases but in all five it was present in the cecum and ascending colon by the twenty fourth hour.

For a proper evaluation of these observations it must be remembered that the time normally required for the chyme to travel through the small bowel is highly variable. Besides individual differences the type and quantity of food and the mode and site of its introduction (oral ingesting intubation or fistula feeding) are important factors.

In postoperative patients, the rate of transport is subject also to influence by medication. It is currently stated that three to five hours

TABLE I

SERIAL RADIOGRAPHIC OBSERVATIONS OF THE INTESTINAL TRACTS OF JEJUNOSTOMY PATIENTS WITHIN TWO DAYS OF OPERATION TO SHOW THE RATE OF TRANSPORT OF PREDIGESTED ALIMENT

Section of Bowel	Patient	Number of Hours after Injection of Radiopaque Aliment*				
		1	2	3	5	20-24
Jejunum	M M	+++	++	++	0	
	S H	+++	+++	+++	++	0
	I G	+++	+++	++	++	0
	J L	+++	+++	++	0	0
	J B				tr	0
Ileum	M M	+	++	++	0	
	S H	0	+	+	++	+
	I G	0	0	++	++	0
	J L	0	0	++	+++	+
	J B				+++	++
Cecum	M M	0	0	0	++	
	S H	0	0	0	0	+++
	I G	0	0	0	0	+
	J L	0	0	0	tr	+++
	J B				0	++
Ascending Colon	M M	0	0	0	0	
	S H	0	0	0	0	+
	I G	0	0	0	0	+++
	J L	0	0	0	0	++
	J B				0	++
Transverse Colon	M M	0	0	0	0	
	S H	0	0	0	0	0
	I G	0	0	0	0	++
	J L	0	0	0	0	tr
	J B				0	0
Descending Colon	M M	0	0	0	0	
	S H	0	0	0	0	0
	I G	0	0	0	0	tr
	J L	0	0	0	0	0
	J B				0	0

* All of these x-ray series were started about twenty-four hours after operation with the exception of one (M M) when the time was forty hours.

Plus marks indicate the relative density of radiopacity. A blank space indicates that no radiograph was taken.

are required for a suspension of barium sulfate to pass through the normal small bowel, following oral ingestion.^{1, 6} However, 500 to 1000

cc of a thin barium sulfate suspension, allowed to flow freely into the duodenum by oral intubation, frequently reached the cecum in fifteen minutes^{3 4 7 8} and in a few cases only five minutes have been required. Comparison of our results with rates cited from the literature is not valid, since previous workers employed five to ten times as much opaque suspension as was used in this study. Furthermore, our rate

TABLE 2

SERIAL RADIOGRAPHIC OBSERVATIONS OF THE INTESTINAL TRACTS OF JEJUNOSTOMY PATIENTS THREE TO FIVE WEEKS AFTER OPERATION TO SHOW THE RATE OF TRANSPORT OF PREDIGESTED ALIMENT

Section of Bowel	Patient	Number of Hours after Injection of Radiopaque Aliment*				
		1	2	3	5-10	20-24
Jejunum	S H	+++	++	++	+	
	I G	++	+			
	J B	tr	tr	0	0	0
Ileum	S H	0	++	++	++	
	I G	+	+++			
	J B	++	++	++	0	0
Cecum	S H	0	0	0	++	
	I G	tr	+			
	J B	++	++	+++	++	tr
Ascending Colon	S H	0	0	0	+	
	I G	tr	tr			
	J B	+	+	+	++	tr
Transverse Colon	S H	0	0	0	0	
	I G	0	tr			
	J B	0	0	tr	+	+++
Descending Colon	S H	0	0	0	0	
	I G	0	0			
	J B	0	0	0	0	tr

* Plus marks indicate the relative density of radiopacity. A blank space indicates no radiograph was taken.

of administration was invariably 100 cc per five minutes, whereas the others reported rates considerably greater than this—e.g. as much as 1000 cc per fifteen minutes. And finally, other investigators have used a wholly inert medium whereas we suspended the barium sulfate in the predigested aliment.

Hence, it was necessary to establish control values under essentially the same conditions as those employed in the tests. For this

purpose, serial radiography was repeated in three of the patients, three to five weeks after operation, when it was assumed that the rate of propulsive activity had returned to normal. Also, at that time, medication was no longer a disturbing factor. Comparison of Tables 1 and 2 reveals a generally higher rate of propulsion several weeks after operation than during the second day. The head of the contrast material was already present in the cecum by the end of the first hour in two of the three patients, but in the third it required over three hours to reach this level. Complete emptying of the small bowel required three to five hours in at least one case, and probably in a second as well. The third case required well over ten hours. Thus, the rate of transport was below normal shortly after operation, but the observations indicate that it was sufficiently rapid to obviate the accumulation of aliment near the site of injection. This is confirmed by the absence of any sign of jejunal distention in the one hour films. The presence of segmentation in all of the radiographs supports the view that the aliment is transported through the bowel by active peristalsis. Retrograde movement of the aliment was never observed in the five early postoperative studies, neither the duodenum nor the stomach was visualized in this series. In one of the control series, on whom a gastroenterostomy had been performed, some of the contrast material was carried into the stomach through the stoma, even in this case however, the duodenum was not visualized.

CONCLUSIONS

It may be concluded that jejunal feeding with our predigested aliment may be instituted as early as twenty four hours following operation, provided certain precautions are adhered to. Even in the presence of an upper abdominal peritonitis, such as was encountered in patient J.B., early alimentation is feasible. This has already been recognized by Charrier.² Furthermore, because of the absence of retrograde movement of the aliment, it seems likely that this feeding procedure does not jeopardize the weak spot of gastric surgery, the duodenal stump. Nevertheless, special precautions concerning volume and rate of administration of aliment, previously described,³ must be taken during the early days following operation.

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NONTUMID ILEOCOLIC INTUSSUSCEPTION IN AN ADULT

Report of a Case with Cecal Ulcer

LESTER BLUNT, M.D., F.A.C.S.*

IN view of its comparative rarity, it should seem of interest to present the case of an adult with intussusception unaccompanied by intestinal tumor

In an extensive study of this condition, involving 300 cases from all causes, Eliot and Corseaden¹ stated that about 10 per cent of hospital admissions for intussusception occurred in adults. In their review of 400 cases Ferrin and Lindsay² found that in eighteen cases, or about 5 per cent, the patients were over 14 years of age. It would seem reasonable therefore to expect that five to ten cases in every hundred of intussusception would be in adults.

Some idea as to the infrequency of the nontumid variety can be gained from the report of Botsford and Newton³ that only five adults with intussusception were admitted to the Peter Bent Brigham Hospital between the years 1913 and 1940 and in only one of these cases was there no evident exciting cause. In three other unselected short series one in four,⁴ one in four and one in six⁵ cases showed no tumor either neoplastic or inflammatory. The contrast between the usual association of tumor with intussusception in the adult and its absence in the same condition in infancy leads to a consideration of pathogenesis.

ETIOLOGY

There is no disagreement as to the mechanism of this process in the presence of a tumor. The normal pattern of peristaltic activity could reasonably be expected to invaginate the mass whether intramural or intraluminal into the segment of bowel immediately below, thus initiating the process. However, where there is no abnormality of that portion of the intestine which forms the apex of the intussusception it is not easy to formulate a theory as to its cause which readily answers all objections. While Lichtenstern's⁷ is considered the first authoritative study and his classification of enteric, ileocolic, ileocecal and cecocolic is still used, the short paper by John Hunter⁸ which was read on August 18, 1789 contains the gist of all that has been writ-

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ten since In five short pages Hunter defines "Introsusception," offers a plausible explanation for its occurrence, describes in detail its morbid anatomy and warns of the difficulties of clinical diagnosis In his consideration of etiology Hunter suggests that the invagination of a contracted portion of gut into the relaxed segment below might well be a common physiologic accident That if, for some unknown reason, this should persist, so that the bowel below draws itself up on the inner segment, then an intussusception arises which grows at the expense of the ensheathing bowel In the subsequent literature, as in Clubbe's⁹ monograph and the article of Watts,¹² this is known as Nothnagel's theory because it was elaborated upon by Nothnagel one hundred years later

Since 97 per cent of cases start at or near the ileocecal junction, the theories of causation are naturally related to the anatomy of this region They include the following concepts ^{10 11 12}

- 1 That the ileocecal valve normally projects through the wall of the cecum so that during the discharge of intestinal contents it telescopes into the lumen of the large gut When due to some derangement of intestinal rhythm this may become marked, the process may overreach itself and an intussusception of the usual type with the ileocecal valve as the apex can be so started,
- 2 That the base of the appendix due to a local inflammatory process can similarly be the initial point and drag the adjacent ileocecal valve with it as the forefront of the intussusceptum,
- 3 That the lymphoid tissue aggregates (Peyer's patches), which are of considerable size during the first year of life and may persist in an enlarged form serve as intramural tumors and so start the process in the last inch or two of the ileum,
- 4 That the slope of the mesentery that is the angle at which the ileum joins with the cecum may tend to precipitate invagination of the small into the large bowel and that the reason for its predominance in the male is related to the more obtuse ileocolic angle in infants of this sex
- 5 That the mesentery may be unusually long and that the peritoneum enclosing the ascending colon may be unusually lax resulting in a mobile caput cecum

There is one point of physiologic importance that has heretofore been overlooked in this connection The ileocecal region is believed to be the junction of the vagal and sacral portions of the parasympathetic system It is conceivable that a protective mechanism acting

through the autonomic chains might tend to release any spontaneous invaginations along the intestinal tract that would otherwise progress to intussusceptions. At the ileocecal junction, invagination would result in the intussusceptum having an extrinsic innervation from the cranial part of the parasympathetic nervous system, while the enveloping sheath or intussuscipiens would be supplied by the sacral portion. If such a protective mechanism were to exist it might therefore reasonably be expected to fail at the very site where intussusception without causative tumor invariably occurs. Since there is good reason to believe that edema of the apex of the intussusceptum develops in a matter of minutes the progression of a process so initiated would then be furthered by peristalsis.

That functional derangements of the intestine on a presumptively neural basis can result in dramatic clinical pictures has been shown by Colp¹³ who reviewed the extensive literature on the subject and reported five cases of proven colonic spasm causing intestinal obstruction. Zimmerman¹⁴ in a study of spastic ileus was led to believe that stimuli arising in any portion of the nervous apparatus supplying the gut might initiate spasm.

Certainly the five popular theories of causation, tabulated above, possess no firm foundation in fact. This additional postulate of a protective sympathetic mechanism, weakest at the ileocecal junction because of the transition from the vagal to the sacral parasympathetic is equally logical and just as hypothetical.

DIAGNOSIS

The case presented here demonstrates the indefinite nature of the clinical findings and the importance of the roentgen examination in making the diagnosis. Brocq and Cucullette⁵ have described the common x-ray patterns found by barium enema (see Fig 161). Sussman¹⁵ emphasized the importance of the roentgen appearance following defecation. In fact he established the following diagnostic criteria:

- 1 Obstruction to the passage of barium given either by meal or enema but not often both.
- 2 A filling defect at the site of obstruction of varied appearance,
- 3 A palpable mass at the site of obstruction,
- 4 A change in the position and shape of the filling defect following defecation,
- 5 A compression of the adjacent mucosal folds particularly well seen in the postdefecation films.



Fig 161 -Roentgenogram showing intussusceptum in transverse colon

CASE REPORT

N. R. a 44 year old Puerto Rican working man, was admitted to the Mount Sinai Hospital, service of Dr Ralph Colp on June 21 1946. His chief complaint was one of colicky abdominal pain of two days duration. The family history was irrelevant, four siblings living and well, and the only two occasions on which he had consulted a doctor were for pneumonia in 1916 and mastoidotomy in 1938. He had been well until four days before admission, when after eating a pork chop, he experienced severe colicky pain in the hypogastrium. After a few hours the pain ceased but recurred the next day and continued up to the time of entering the hospital. He had been constipated since the attack began and noticed some slight distention. He had felt nauseated but had not vomited. There was no history of diarrhea or blood in the stools.

Physical examination revealed a well developed middle aged muscular male in acute distress. The blood pressure, pulse and temperature were normal. Examination of the head and chest were negative. The abdomen was slightly distended and tender in the lower quadrants. There were no masses, the liver and spleen were not felt. Rectal examination was negative. The hemoglobin was 65 per

nt, the icterus index was 6, the Wassermann test negative, and the blood chemistry figures, except for a total protein of 5.5 gm, were normal. Examination of the stools was negative for blood, parasites and ova.

The first impression was that this was a gastroenteritis or food poisoning, but on the second day of hospitalization a member of the house staff stated that he felt a mass to the right of the umbilicus. A gallbladder x-ray series was negative. The sedimentation rate was normal, and there was no fever. One week after admission the patient passed a semiliquid stool which showed a trace of blood on the guaiac test and at this time began to complain of intermittent right upper quadrant pain which lasted up until the time of operation. On July 1, barium enema examination by Dr. M. L. Sussman showed a large filling defect in the proximal transverse colon. The ascending colon was not visualized. In the region of the defect the mucosal folds of the colon could be seen outlined around an intraluminal mass. The roentgen appearance was considered to be that of an intussusception. It was about this time, ten days after the patient's admission, that a rather firm nontender mass could be identified occupying the right side of the abdomen. Just preceding operation the mass evidently extended across the midline into the left hypochondrium.

On July 8, 1946 the abdomen was entered through a left rectus incision and the mass was discovered to be an intussusception of the terminal ileum and cecum into the ascending and transverse colons ending just to the right of the splenic flexure. There was no evidence of a discrete tumor and none of disseminated malignant disease. An ileosigmoidostomy was performed, the point of division of the ileum being 8 inches from the beginning of the invagination.

The patient did well and on July 25, 1946 an ileocolic resection was performed. At this time the head of the intussusceptum lay in the hepatic flexure. The specimen consisted of 20 cm of ileum, the ascending colon and two thirds of the transverse colon. Following this procedure the patient recovered rather slowly and began to show a melena which had not been present before. There was a superficial infection in the lower angle of the wound which cleared up rapidly. Finally roentgen examination disclosed a persistently deformed duodenal bulb. On the institution of a peptic ulcer regimen the melena disappeared, the patient gained weight and strength and was finally discharged well on August 18, 1946. Examination of the specimen by Dr. A. D. Pollack revealed an intussusception of the ileum and cecum into the ascending colon. There was a large chronic granulomatous ulcer of the ascending colon. Both colon and ileum showed epithelioid nodules and old parasitic ova. It was suggested that the stools be examined for *Schistosoma mansoni*. When the bowel was opened the first portion of the ascending colon presented this area of induration and shallow granular ulceration 5.5 cm in diameter. There was no evidence of either neoplastic or inflammatory tumor.

Comment.—Since the intussusception began proximal to the site of the nonspecific ulcer, the only conceivable part that this lesion could have played in the mechanism of the invagination is that of an irritant which may have disturbed the rhythm as well as increased the force of peristalsis. Eliot and Corseaden¹ in fact ascribed some of their cases to typhoid and dysentery ulcers. However, when the frequency of these diseases at the time of their report (1911 and preceding



Fig 161—Roentgenogram showing intussusceptum in transverse colon

CASE REPORT

N R a 44 year old Puerto Rican working man was admitted to the Mount Sinai Hospital service of Dr Ralph Crisp on June 21 1946 His chief complaint was one of colicky abdominal pain of two days duration The family history was irrelevant, four siblings living and well and the only two occasions on which he had consulted a doctor were for pneumonia in 1916 and mastoidectomy in 1930 He had been well until four days before admission when after eating a pork chop he experienced severe colicky pain in the hypogastrum After a few hours the pain ceased but recurred the next day and continued up to the time of entering the hospital He had been constipated since the pain began and noticed some slight weight loss There was no history of

acute distress The blood pressure pulse and temperature were normal Examination of the head and chest were negative The abdomen was slightly distended and tender in the lower quadrants There were no masses the liver and spleen were not felt Rectal examination was negative The hemoglobin was 85 per

INTUSSUSCEPTING SUBMUCOUS LIPOMA OF RIGHT COLON

GEORGE T. PACK, M.D., F.A.C.S.* AND ROBERT J. BOOHER, M.D.†

In the first comprehensive review of submucous lipoma of the gastrointestinal tract, Stetten,¹ in 1909 stated that "something will have been accomplished by this paper if the surgeon's attention will have been directed to the possibility of the presence of this lesion, either prior to or during operation, when he is face to face with an obscure abdominal case." In his review of seventy seven cases up to that time, he was surprised at the comparative frequency of this tumor and quite astounded at the "really grave complications to which it can give rise." To illustrate Stetten's prophetic generalization on this tumor and to recall it to the attention of abdominal surgeons, we wish to report two more cases of submucous lipoma of the cecum and ascending colon.

HISTORICAL REVIEW AND INCIDENCE

Stetten's series included seventy seven cases, sixty seven of which were intestinal in origin, and 73 per cent of the entire group produced symptoms. In 1931 Comfort² analyzed 181 cases of submucous lipoma of the gastrointestinal tract, then available for study. Of these, 114 or 59 per cent provoked symptoms, and in sixty seven instances they were asymptomatic. In ninety-two of these patients the colon or rectum was involved, sixty five were in the small intestine and twenty two were in the stomach. Poston,³ in 1934, in an attempt to collect and correlate reports from all sources, recorded 242 cases, 121 of which were at or below the ileocecal valve. Weiner and Polayes⁴ compiled 259 cases up to 1938, 139 being at or below the ileocecal valve. Schottenfeld⁵ in 1943 reviewed a total of 38,741 autopsy reports from various authors and found forty six cases, an incidence of 0.118 per cent. He stated that approximately 275 cases throughout the gastrointestinal tract have been compiled giving an approximate incidence of 56 per cent in the small intestine with the remainder in stomach, colon or rectum, a preponderance not noted by Comfort who found

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years) is contrasted with the rarity of this type of adult intussusception, a causal relationship is again a matter of dispute

SUMMARY

A case of nontumid intussusception in a middle-aged adult is presented with a discussion of the factors entering into its pathogenesis

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CASE REPORTS

stomach were taken and reported to be negative, and under *barium enema* and *barium* therapy he was relieved. Two years later he developed melena for which he was admitted to a hospital for four weeks and for which blood transfusions were given. X-ray studies, however, were again reported as normal. One year and a half before, that is, four and one-half years after onset of symptoms, he had an attack of bearing-down intense abdominal pain, associated with constipation for three or four days. He became distended and vomited. The attack passed without medical attention or treatment. He had similar attacks every three months since, but in the preceding three months they had become quite severe and had recurred about every two weeks. When he attempted to move his bowels he would have prolapse of the rectal mucosa, he had been told this was a protrusion of a rectal polyp.

In June of 1942 he was referred to another hospital where a most complete examination was done. The gastrointestinal series was normal. X-ray examination of the colon following a barium enema, however, showed that there was an extreme degree of distensibility of the entire large bowel which constituted a in the region
it only hemor-

Physical examination revealed a middle-aged male who appeared to enjoy good health. His weight was 161 pounds. The lungs were clear to percussion and auscultation. Blood pressure was 150/93 mm of mercury. The abdomen was mildly distended and the stomach was somewhat distended with fluid. The liver and spleen were not enlarged, but the sigmoid seemed abnormally large. Digital rectal examination revealed a few external hemorrhoids. The rectal tissues seemed quite loose but no polyps were seen on sigmoidoscopy and proctoscopy.

Laboratory studies showed the erythrocyte count to be 4,300,000 per cu mm and the hemoglobin 87 per cent. The white blood count was 7150 per cu mm with a normal differential distribution. Urinalysis was normal. The chemical analysis of blood constituents was: serum chlorides, 100 meq/L; serum protein 6.9 gm per 100 cc; blood sugar, 112.4 mg per 100 cc; blood urea nitrogen, 19.8 mg per 100 cc; and prothrombin time, 82 per cent of normal.

X-ray study after a barium enema on September 10, 1943, showed a very tortuous and greatly dilated colon which took a long time to fill and into which approximately 4½ quarts of barium mixture were injected. It was the impression that this patient had a megacolon, but it was noted that as the barium column advanced upward into the large intestine, it outlined some round masses which later, upon complete filling of a given portion of the colon, disappeared. The impression was that they were either fecal masses or polyps, and they were most suspected in the region of the sigmoid colon and the hepatic flexure. It was decided that, owing to the long history of six years' duration, and many negative examinations, exploratory laparotomy was in order. A presumptive diagnosis of benign tumor of the colon was entertained though its location was undetermined.

The patient was therefore admitted to the hospital on September 4, 1943,

the lesion to occur almost twice as commonly in the colon and rectum as in the small intestine.

Pemberton and McCormack⁶ confined their study to lipomas of the colon and rectum and in 1937 collected a total of 116 cases, ninety four of which were the cause of symptoms nineteen were found at necropsy Gault and Kaplan⁷ four years later brought the total to 150 cases In 111 patients symptoms led to the finding of the submucous variety of lipoma of the colon and rectum In 1943 Helwig⁸ reported 1460 consecutive autopsies in which

This would indicate that the cecum and contiguous ascending colon is the most common site of lipoma in the large intestine the conclusion that Comfort reached while Stetten found the predominance in the sigmoid colon and rectum In fifty of the 116 cases of Pemberton and McCormack the tumor was situated between the ileocecal valve and the hepatic flexure

Since Gault and Kaplan's review in 1941 ten more cases occurring in the colon and rectum have been recorded. One Cabot Case report⁹ in 1941 dealt with a lipoma in the hepatic flexure causing intussusception. Saint¹⁰ recorded one case necessitating ileocolic resection. Mannheim's¹¹ case occurred in the midsigmoid and was spontaneously extruded, the twentieth time surgical intervention was obviated by this bizarre event. Schottenfeld in 1943 reported six cases of gastrointestinal submucous lipoma four of which were in the colon. One of these was in the transverse colon and was the only one producing symptoms in this group. It caused intussusception. The other three were found as an incidental finding at autopsy. One was in the ascending colon, one case presented multiple lipomas of the cecum and ascending colon, and the fourth occurred in the transverse colon but the primary lesion was a carcinoma of the ascending colon. Moore¹² presented a lesion the size of a lemon occurring at the hepatic flexure giving acute symptoms of only four days duration. Browne and Hardy's¹³ case not only presented intussusception as a complication but also multiple submucosal lipomas and a mucocoele of the appendix. Iason¹⁴ found a submucous lipoma of the midpart of the transverse colon causing intussusception. This brings the total number of reported cases occurring in the colon and rectum to 153.

3 by 6 by 5 cm in its largest diameter. The surface of this tumor is very nodular and has a variegated appearance, part of it being very congested and red, other areas being almost yellowish in color. The pedicle of the polypoid tumor measures 2.2 cm in diameter. It arises from the region of the ileocecal valve. A portion of the pedicle is on the cecal side and the other portion on the side of the ileum. The tumor is rather soft in consistency and on section is seen to consist almost



Fig. 163—The x ray after barium enema in Case II. The colon fills well up to the area of the hepatic flexure. It was interpreted that a centrally placed mass prevented filling of the right colon which is distended with gas.

entirely of lobulated fatty tissue which has a rim of mucosa and thin muscularis covering the central fatty tissue. The mucosa of the terminal ileum, cecum and ascending colon all appears to be normal. The diagnosis was pedunculated submucous lipoma of the ileocecal region.

On December 13, 1943, the patient was admitted to the hospital again and an extraperitoneal closure of the double-barreled colostomy was done after crushing the spur.

with a presumptive diagnosis of polyposis of the colon. On September 2nd 1943, under spinal anesthesia, an exploratory laparotomy was done through a right rectus incision. The greatly dilated sigmoid was again found, and it was estimated to be approximately 2 feet in length. In the cecum a pedunculated tumor about 10 cm. in diameter was palpable, and it appeared to arise from the ileocecal valve. The ileum was greatly distended, measuring approximately 8 cm. in diameter and the walls were thickened. An egg shaped portion of soft tissue about 4 by 2 cm. was present in the mesentery of the cecum, adjacent to the origin of the tumor. Because of the marked distention of the lower ileum and the ascending colon, it



Fig. 162 (Case I) —This photograph shows a large nodular submucous pedunculated lipoma arising from the ileocecal valve

was decided to do an obstructive type of resection with an external ileostomy. The patient made an uneventful postoperative recovery and was discharged from the hospital on October 24 1943 on his 27th postoperative day.

The pathological report was as follows. Specimen consists of the cecum together with a portion of ascending colon which together measures 23 cm. in length. (Fig. 162.) Also included is the appendix and 6 cm. of the terminal ileum. The peritoneal surface of the specimen appears normal. The lumen is patent throughout. A rather large tumor can be palpated within the lumen of the cecum. On opening into the gut a large pedunculated tumor is seen. The tumor has the gross appearance of an extremely large polyp which measures

SIGNS AND SYMPTOMS OF SUBMUCOUS COLONIC LIPOMAS

As we have noted above, a few of these tumors may not cause symptoms, but the majority do *evolve* evidence of their presence. Our two cases are quite typical of a large group of these tumors because the symptoms were present intermittently for many years. Pemberton and McCormack have analyzed this group. They found the attacks have lasted from a few minutes to several days, and the patient enjoys good health between the episodes. There is no periodicity of attacks. Coming on at any time, they are really symptoms of acute intestinal obstruction, with colicky pain, distention, nausea and sometimes vomiting the episode sometimes being relieved by a bowel movement. These symptoms in our patients seemed to be caused by transitory intussusception as was shown by the roentgen studies in our second patient. Frank intussusception was not found at laparotomy in either case.

Intussusception has been a characteristic complication of these lesions, eighteen acute and five chronic intussusceptions and six chronic inversions, a total of 29 or 43 per cent, being noted in the sixty seven intestinal cases collected by Stetten and in four of the thirteen cases collected by Gault and Kaplan. Schottenfeld's analysis of 275 cases of gastrointestinal lipomas showed that about 38 per cent terminated in intussusception. Lazarus and Marks¹³ state that intussusception was found in 45 per cent of the reported cases, the tumor always being found at the tip of the intussusception, as emphasized by Stetten. Christopher¹⁴ found eleven lipomas in a collective review of forty three cases of benign tumor causing obstruction. These usually comprise the second group of patients who present symptoms of short duration, a matter of a few days. The picture is that of acute intestinal obstruction and the cause, acute intussusception which is irreducible although obstruction without invagination of the bowel may occur.

Browne and Hardy combined the findings of Pemberton and McCormack, and Gault and Kaplan to show that pain was a symptom in 75.2 per cent of the cases, palpable tumor, 74.2 per cent, constipation 53.4 per cent, weight loss, 11.6 per cent, and bleeding sufficient to produce anemia, 7.9 per cent. It would seem that symptoms first spring from tension on the stalk of the pedunculated tumor, the probable cause of the colicky pain. Eventually the tumor grows to a point at which greater motor activity is produced and intussusception occurs. Constipation may be a factor either because of the transitory obstruction or motor imbalance of the colon that underlies the transi-

contains a moderate amount of

the hepatic
is normal

appearing mucosa which contains several areas of erosion, the largest being 0.5 cm in its greatest diameter. The tumor is soft. It rests upon the mucosa of the cecum and has resulted in pressure atrophy at that area. The tumor is composed of well-circumscribed, encapsulated, lobulated fat tissue. The capsule is thin. There are no areas of infiltration. No lymph nodes were discovered in the mesentery.

glance



Fig 165—Photograph of the resected specimen in Case II. The lipoma arises from a long stalk covered by normal mucosa. The tumor itself is covered by atrophic mucosa with several areas of erosion not being apparent.

a moderate inflammatory infiltration of lymphocytes and eosinophils and a few plasma cells. In several sites this infiltration is focal in nature. The muscularis is absent except for a few atrophic strands of the muscularis mucosa. Below the desmoplastic submucosa is a lipoma characterized by the usual fat cells with a slight increase in the dimension of the fibrous septae. Sections from the colon at other sites reveal no significant signs except for atrophy of the mucosa at the site of support of the dependent portion of the tumor. Examination of the lymph nodes reveals no evidence of tumor tissue. The nodes are characteristic of those found in the site of a chronic inflammatory process. Diagnosis: Submucous lipoma of the ascending colon."

On October 13, 1946, approximately two months after the first operation, trapezontal closure of the colostomy was done with an uneventful postoperative course.

case demand. Of course local excision or primary resection is the treatment of choice if conditions warrant. The surgeon likewise must not overlook another asymptomatic lipoma or an associated polyp which may later cause symptoms. Oughterson and Cheever¹⁷ have indicated this necessity in their collected series of recurring intussusceptions due to intestinal neoplasms which required multiple operations for relief. We subscribe to their conclusion that every tumor of the gastrointestinal tract especially if it is situated within the lumen of the intestine no matter how benign the character of the growth should be removed unless there is definite contraindication since it always carries with it the threat of intussusception.

In our cases the first case demanded obstructive ileocolic resection with ileotransversostomy because of chronic intermittent ileocecal obstruction. The second case would have been amenable to primary resection and anastomosis but the exteriorization procedure seemed to be the safer procedure.

CONCLUSIONS

1. Something will have been accomplished by this paper if the surgeon's attention will have been directed to the possibility of the presence of this lesion either prior to or during operation when he is face to face with an obscure abdominal case" (Stetten).

2. In cases of obscure abdominal pain occurring intermittently for a long time with intervening episodes of complete freedom from pain with signs and symptoms of transitory obstruction associated with a palpable mass especially if in the right half of the colon a tentative diagnosis of intussusception due to benign tumor may be in order.

3. A total of 153 cases of submucous lipoma from and including the ileocecal valve to the rectum has been previously reported.

4. Two cases of submucous lipomas of the colon are reported one arising from the ileocecal valve producing chronic obstruction on the basis of intermittent reducible intussusception and one in the ascending colon producing intermittent transitory intussusception.

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tory bouts of intussusception. Sometimes the surface of the lesion may ulcerate to produce chronic bleeding and resultant anemia, or the entire lesion may be spontaneously extruded. A mass, if present, is usually due to intussusception, while the temporary obstruction is associated with distention and hyperperistalsis.

DIAGNOSIS

A correct preoperative diagnosis of this condition is rarely to be expected. However, in cases of obscure abdominal pain occurring intermittently for a long time with intervening episodes of complete freedom from pain, with signs and symptoms of transitory obstruction associated with a palpable mass, especially if in the right half of the colon, a tentative diagnosis of intussusception due to a benign tumor may be in order. Yet the possibility of this benign tumor being an adenoma is greater than the likelihood of its being a lipoma. The roentgen studies may be of value. Between acute episodes it may show a polypoid tumor mass in the colon, while in the obstruction of intussusception the characteristic filling defects of the enterocolic or colic intussusceptum projecting into the intussusceptiens, the so-called en sheathment pattern, may be found. The general age group of these patients is usually the "cancer age group," but lack of physical deterioration compatible with the long history involved will usually indicate a benign process rather than cancer. Even after opening of the abdomen, the presence of a polypoid tumor with tributary hyperplastic lymph nodes due to inflammatory reaction in the segment of bowel harboring the tumor may still be more indicative of a malignant tumor than of a lipoma.

TREATMENT

The treatment of the tumor depends in great part upon the complications the lesion has produced in becoming symptomatic. If, a rarely happens, a diagnosis of benign pedunculated tumor is made preoperatively, simple enterotomy for local excision will probably suffice, though simple resection with primary anastomosis may be necessary. If obstruction exists, the diagnosis will probably be masked, but regardless, an obstructive resection or exteriorization operation will be in order. If the problem is that of acute intussusception the lesion may be reduced and the problem handled as if it were an uncomplicated tumor of the colon, but more probably the entire lesion tumor and intussuscepted bowel together will have to be resected or exteriorized, as the condition of the bowel and the exigencies of the

SALMONELLA TYPHI MURIUM CHOLANGITIS TREATED WITH STREPTOMYCIN

DAVID A. DREILING, M.D.*

THERE has been increasing recognition in the past decade that the so called animal salmonella bacterial group was not only the cause of gastroenteric fevers^{3, 5, 12} of varying severity but also produced, in man, a great variety of clinical syndromes. *Salmonella typhi* murium, a natural pathogen of fowl and rodents,¹³ has been reported as the etiological organism in pneumonia,¹⁴ empyema,⁴ osteomyelitis,¹ peritonitis,⁸ endocarditis,⁸ cholecystitis,¹⁵ meningitis,¹¹ encephalitis¹² and obscure septicemias.⁶ These cases have been gathered mainly from publications emanating from South America, Australia and China, countries in which the endemic focus is heavier than in the United States and in which the methods of sanitation have not yet brought under control food borne epidemics. It appears not untimely to review the possibilities of salmonellosis and its treatment in anticipation of epidemic outbreaks which may result from the present day population shifts, overcrowding and breakdown of sanitation throughout the world. The reported case of *Salmonella typhi* murium cholangitis adds another case of localization of this type of infection to the literature.

CASE REPORT

The patient, a 54 year old woman, entered Mount Sinai Hospital on May 11, 1945, with severe obstructive jaundice. Two years previously she had suffered for four weeks an attack of febrile diarrhea which had been diagnosed as typhoid fever. This initial illness was followed within eight weeks by a transient seizure of right upper quadrant colicky pain associated with nausea and vomiting and relieved by morphine. She was then asymptomatic until four weeks prior to hospitalization when her present sickness commenced with typical biliary colic, jaundice, chills and fever up to 105°F. A diagnosis of recurrent typhoid fever was made at another hospital despite negative agglutinin titers and failure to isolate the organism from the blood, stool or duodenal juice. Sulfonamide and penicillin chemotherapy in adequate dosage was ineffective.

On admission the patient appeared critically ill. She was deeply icteric. The temperature was 103°F. The only significant physical finding was a tender liver palpable three fingerbreadths below the right costal margin. Laboratory investigation disclosed a hemoglobin of 59 per cent and a white blood count of 10,000.

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er and jaundice persisted in spite of external biliary drainage. Lipiodol injected to the cholecystostomy visualized a markedly dilated biliary tract and outlined large stone completely obstructing the distal end of the common duct (Fig 166)

Accordingly, several weeks later, on June 16, 1945, choledocholithotomy with tube drainage was performed. Thick pus, obtained from the hugely dilated

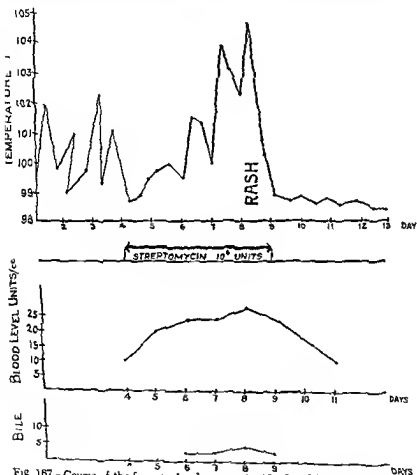


Fig 167—Course of the fever with relation to the blood and bile levels of streptomycin.

culture of *Salmonella typhi murium* from the stool. Repeat serum agglutinal strain.

...ing choledocholithotomy was marked but low grade fever and jaundice continued. Lipiodol injected postoperatively by T tube passed promptly through a biliary tree of normal caliber into the duodenum. The fever

with a shift to the left. The icterus index was 38 the cephalin flocculation 2 plus. The urine and stool were strongly positive for bile and urobilin. No liver damage was revealed by the cholesterol-ester ratio the hippuric acid excretion, or the galactose tolerance tests. Blood and stool cultures were negative. There was no elevation of the typhoid, paratyphoid or dysentery agglutinins. X ray of the abdomen was negative.



Fig. 166—Postcholecystostomy cholangiogram outlining a stone obstructing the common duct

The patient's general condition deteriorated rapidly during the first few days of hospitalization by which time a diagnosis of severe acute cholangitis was made. Because of her desperate state a cholecystostomy was performed on May 16, 1945 under local anesthesia. The gallbladder was acutely inflamed and distended with 400 cc of purulent bile (*Escherichia coli*). One stone was removed from the fundus. Biopsy of the wall showed subacute inflammatory changes.

Postoperatively the patient's general condition improved slightly but chills

ceded the infection or was the result of it is unknown, but, in the presence of the biliary obstruction which developed, the infection spread throughout the biliary tree producing a suppurative cholangitis.

The poor response to cholecystostomy is not surprising, for the biliary tract is never satisfactorily drained by a cholecystostomy. The



Fig 168—Droplets of lipiodol can be seen throughout the hepatic parenchyma two weeks after a cholangiogram.

failure of choledocholithotomy and drainage of the common duct may be ascribed to the unfortunate presence of a suppurative cholangiectasis. The droplets of lipiodol (Fig 168) and the unsatisfactory response of suppurative cholangiectasis to chemotherapy parallels the results in the treatment of bronchiectasis.

and jaundice, therefore, were ascribed to infection rather than biliary obstruction. Attempts to control this residual cholangitis (*S. typhi* murum) with sulfadiazine, N U. 445 (a sulfonamide derivative more effective in vitro against gram negative bacteria) and massive penicillin were without avail. Because of the remote possibility of a residual intrahepatic suppurative focus, the patient was subjected to a third laparotomy, at which time the liver was aspirated in several directions with negative results. Biopsy of the liver showed multiple liver thrombi, culture yielded *Salmonella typhi* murum.

Streptomycin was then obtained for the patient. The organism in vitro was found to be susceptible to 8 units of the drug per cubic centimeter of blood. Two million units in divided doses (every six hours) was given intramuscularly for five days (total, 10 million units). A blood level of 20 units per cubic centimeter (well above the susceptibility range) was maintained during this period. In the bile the maximum concentration was five units (Fig. 167). The fever rose slowly during the course of streptomycin therapy reaching on the fifth day 104° F. At this point a conjunctivitis and generalized eruption, very similar to the toxic rash of the sulfonamides, appeared. The patient was then discharged.

At the end of this time, however, the organism was again cultured from the bile and low grade fever reappeared.

The patient was discharged on November 5, 1945, febrile, anicteric, and with a T tube in situ. She was readmitted two months later for reevaluation. The icterus under now was only 3. *Salmonella typhi* murum still could be grown from the bile. The organism was sensitive to 4 units of streptomycin per cubic centimeter of blood. Standard tests showed no decline in liver function. The stools were brown and the urine contained no bile. Except for fever, the patient had no symptoms and had continued to gain weight. A specific vaccine was prepared and the patient was again discharged to a convalescent home where the vaccine was administered.

Four weeks later the situation was unchanged. In order to remove the one remaining focus of infection a cholecystectomy was performed on January 24, 1946, under spinal anesthesia. The gallbladder was chronically inflamed, its bile sterile. Biopsy of the liver revealed chronic interstitial inflammation in the periportal fields with beginning biliary cirrhosis. Since then the patient has been febrile but asymptomatic. Minimal biliary drainage persists at the site of drainage of the last operation. The discharge on culture continues to yield *Salmonella typhi* murum.

COMMENT

The course of paratyphoid infections is similar to, though milder than, that of the infection caused by the closely related typhoid bacillus. Thus any of the complications ordinarily seen in typhoid fever may occur.²² In this patient the original attack of "typhoid fever" was rather a *Salmonella typhi* murum gastroenteritis complicated during convalescence by cholecystitis. Whether calculus disease pre-

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Yet in all fairness it must be admitted that salmonella infections, in general, respond capriciously to streptomycin. Furthermore, by present standards, the dosage used in this case cannot be considered adequate. Keefer¹⁶ has reported twenty-six cases of salmonellosis, of which only twelve showed improvement or cure with streptomycin. He advised high dosage (3 to 6 gm per day) and prolonged treatment (two weeks). In the case reviewed an adequate blood level (25 units/cc) was maintained for five days, but the level in the bile (5 units/cc) was well below the sensitivity of the organism (8 units/cc). According to some studies on the distribution of streptomycin in the body,²⁰⁻²¹ the drug appears in the bile in concentrations just below that of the blood. This may be true when the liver and biliary tract are normal, but, in our experience in the treatment of two recent cases of cholangitis, the biliary level was about one fourth that of the blood level. Inadequate concentration at the local site of infection is dangerous. Finland¹⁷ reports that under such circumstances there is a marked tendency for the development of drug fastness. Fortunately this did not occur in this case and there still exists the opportunity for more intensive treatment with streptomycin.

SUMMARY

A case of *Salmonella typhi* murum cholangitis treated surgically and with streptomycin is presented. Other complications of this enteric infection are listed. High dosage and prolonged treatment are advised to eradicate biliary infections.

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SPONTANEOUS RUPTURE OF THE COMMON BILE DUCT FOLLOWING CHOLEDOCHOLITHOTOMY

DAVID A. DREILING, M.D.*

RUPTURE of the common duct is a rare but catastrophic complication of biliary surgery. Although much attention has been given in the recent literature^{11-25 42-54} to spontaneous, nonoperative, atraumatic perforation of the biliary passages, there are only twenty-seven

(1) infection, (2) vascular accident, (3) obstruction and (4) pancreatic reflux. Yet in reviewing the literature, the high incidence of persistent common duct stones (90 per cent) seems more than for tuitous. The following case is presented to reemphasize organic biliary obstruction (calculus) as the most important factor in postoperative rupture of the common bile duct and to suggest that functional obstruction (sphincter spasm) may play a significant role as well.

CASE REPORT

A man, A. K., entered the hospital on October 4, 1945, complaining of high fever, chills and jaundice. In February, 1943, after five years of recurrent attacks of febrile, anicteric biliary colic, a cholecystectomy was performed for acute cholecystitis without stones. Following operation, attacks of colic, fever, chills, and now in addition jaundice, occurred until April, 1945, when a choledocholithotomy with T tube drainage for common duct stone was done. External biliary drainage ceased promptly after the removal of the T tube. The patient was not relieved of his complaints, however, and continued to suffer attacks of colic, fever and jaundice increasing in frequency, severity and duration. He entered the hospital following five days of high fever, chills and jaundice.

Physical examination revealed an acutely ill and jaundiced male. The temperature was 103.8°F. The blood pressure was 105 mm. of mercury systolic and 65 mm. diastolic. The abdomen was slightly distended with moderate generalized voluntary spasm. In the right upper quadrant there was exquisite tenderness above an oblique, well-healed scar. No masses were palpable. Rectal examination was negative. Laboratory investigation disclosed a hemoglobin of 89 per cent and white blood count of 11,600, with normal differential count. The blood urea was 19 mg. per 100 cc., the icterus index 8. The stools were guaiac negative and brown.

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RUPTURE of the common duct is a rare but catastrophic complication of biliary surgery. Although much attention has been given in the recent literature^{11 25 22-24} to spontaneous, nonoperative, atraumatic perforation of the biliary passages, there are only twenty seven case reports¹⁻¹⁰ of postoperative rupture of the choledochus. Newberger,⁸ Mirizzi⁵ and Brunschwig⁴ have discussed at length the pathogenesis of this syndrome and have classified the etiological factors as (1) infection, (2) vascular accident, (3) obstruction and (4) pancreatic reflux. Yet in reviewing the literature, the high incidence of persistent common duct stones (90 per cent) seems more than fortuitous. The following case is presented to reemphasize organic biliary obstruction (calculus) as the most important factor in postoperative rupture of the common bile duct and to suggest that functional obstruction (sphincter spasm) may play a significant role as well.

CASE REPORT

A man A. L., entered the hospital on October 4, 1945, complaining of high fever, chills and jaundice. In February, 1943, after five years of recurrent attacks of febrile, anicteric, biliary colic, a cholecystectomy was performed for acute cholecystitis without stones. Following operation attacks of colic fever, chills, and now in addition jaundice, occurred until April, 1945, when a choledocholithotomy with T tube drainage for common duct stone was done. External biliary drainage ceased promptly after the removal of the T tube. The patient was not relieved of his complaints, however, and continued to suffer attacks of colic, fever and jaundice, increasing in frequency, severity and duration. He entered the hospital following five days of high fever, chills and jaundice.

Physical examination revealed an acutely ill and jaundiced male. The temperature was 103.8°F. The blood pressure was 105 mm. of mercury systolic and 65 mm. diastolic. The abdomen was slightly distended with moderate generalized voluntary spasm. In the right upper quadrant there was exquisite tenderness above an oblique, well healed scar. No masses were palpable. Rectal examination was negative. Laboratory investigation disclosed a hemoglobin of 89 per cent and white blood count of 11,800, with normal differential count. The blood urea was 19 mg. per 100 cc., the icterus index 8. The stools were guaiac negative and brown.

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A diagnosis of peritonitis following either a ruptured choledochus or acute pancreatitis was made but the condition of the patient was so desperate that operative intervention was impossible. Accordingly he was placed in an oxygen tent, a Miller Abbott tube was introduced, parenteral infusions and transfusions were given, and chemotherapy was administered parenterally and intraperitoneally. He remained critically ill until one morning ten days after the exacerbation when a fluctuant bulge was noted in the midportion of the previous laparotomy scar.



Fig 170—Postoperative cholangiogram showing dilated choledochus, a well outlined pancreatic duct, and lipiodol in the duodenum.

This was incised under local anesthesia with the liberation of about 1500 cc of thick, purulent bile. A large tube was inserted. Following this purulent (*Escherichia*), a structure which was interpreted as the duct of Wirsung (Fig 169). No dye entered the duodenum.

in color. The urine showed bile 1 plus urobilin 1/20. Serum amylase activity was reported as 40 Somogyi units.

The impression on admission was that the patient had surgical obstructive jaundice. His general condition was so poor that chemotherapy and parenteral fluids were administered in the hope that the present attack would subside and that exploration could be performed at a more propitious time. On the third



Fig. 169—Postoperative cholangiogram showing marked dilatation of the choledochus and outlining the duct of Wirsung.

hospital day, however, the patient suffered the sudden onset of excruciating abdominal pain starting in the epigastrium and spreading to the entire abdomen. This was associated with nausea, profuse perspiration, dyspnea, extreme asthenia, and pallor. The abdomen became rigid and tender throughout and the blood pressure was unobtainable. X ray showed no air under the diaphragm. Abdominal puncture in the left lower quadrant yielded greenish, odorless fluid containing pancreatic ferments, bile, and gram positive clostridia.

organic obstruction. The added and possibly determining obstructive factor in the causation of rupture was an intensely irritable sphincter. Even following choledocholithotomy this patient displayed roentgenographic, kymographic and biochemical (pancreatic reflux) evidence of increased sphincter tone. Colp^{20, 21} has repeatedly emphasized the importance of this increased tonus and irritability of the sphincter in the production of biliary dysfunction and pancreatic disease. It is also significant that this patient had been receiving large doses of morphine for pain during attacks of colic. Morphine alone may cause intense spasm in an irritable sphincter. The logical sequence of events in the case presented appears to be organic obstruction caused by stone and abetted by a secondary functional spasm of the sphincteric mechanism leading to an increase in intraductal pressure sufficiently great to cause rupture at the point of least resistance, i.e. the site of previous choledochostomy.

Other findings suggestive of sphincter spasm as a contributing mechanism in postoperative common duct rupture are the time relation to operation and the observations at laparotomy in the large group of cases of spontaneous nonoperative nontraumatic biliary rupture.^{11, 13, 22-24} Choledochal rupture may occur ten days to three and one half years postoperatively. In the two longest cases on record^{7, 8} no common duct stone was found at operation! The operative findings in the group of spontaneous rupture without calculus disease and without trauma are just as important. It is true that in some of these cases the rupture can be explained by anomaly of the biliary tree (diverticulum, stenosis^{15, 16}) or infection (inflammatory stricture). But in many instances a normal biliary tree is encountered and here only functional elevation of intraductal tension offers an adequate explanation for the rupture. The most ideal illustrative cases occur in infants^{18, 19} in whom spasm of the duodenum is known to be intense and of long duration.

In the cases of postoperative spontaneous biliary rupture which were reviewed 60 per cent of the patients succumbed to the complication. Despite the rare occurrence of the condition such a high mortality requires consideration as to means of prevention. If biliary obstruction due to stone and sphincter spasm be accepted as the most important etiological factors the problem of prevention resolves itself into more frequent and careful exploration of the common duct when there is a history of jaundice or clay colored stools. When common duct calculi are found a careful search for hepatic duct stones should be made. Endocholedochal sphincterotomy²⁵ may be advisable in

Four weeks later, on November 10, 1945, the patient was discharged to a convalescent home with a temporary biliary fistula. While there the catheter fell out of the fistula, the external biliary drainage ceased, and the patient was returned to the hospital with obstructive jaundice.

Exploration was performed on November 27, 1945, under spinal anesthesia. The fistulous tract was traced to a tremendously dilated common duct to which the duodenum was adherent. Separation of the two structures revealed a large defect in the wall of the common duct through which the previous rupture had taken place and probably through which the previous choledocholithotomy had been performed. A large round stone was removed from the distal common duct after which the duodenum could be easily entered with a probe. The common duct was drained by T tube. Bile removed from the common duct during the operation contained pancreatic ferments and cultured *Escherichia coli* and *B. proteus*.

The postoperative course was benign. Lipiodol injected through the T tube entered a markedly dilated common duct and after some delay flowed into the duodenum. The pancreatic duct was clearly visualized (Fig. 170).

Because of the dilatation of the biliary tract and the evidence of sphincter spasm the patient was discharged on December 14, 1945, with T tube in situ. Six weeks later on February 2, 1946, he returned for further study. He was asymptomatic afebrile and anicteric. Spontaneous external biliary drainage was negligible. Repeat cholangiogram indicated that the biliary tree was no longer dilated and that lipiodol passed promptly into the duodenum. After morphine, however, there was delay in passage and the pancreatic duct could be outlined.

At 1
and

study of the sphincteric resistance²⁷ confirmed this, the initial resistance of the sphincter being 150 mm. of water and the resistance one hour after six minims of Magendie solution being 300 mm. of water. Nevertheless the T tube was removed at this time, just six months after choledocholithotomy. Follow up six months later has shown no indication of persistent disease.

COMMENT

Increased intracholedochal tension due to calculus obstruction and the effects of pancreatic reflux was considered as etiological factors in the postoperative rupture of the common duct in this case. In the production of increased biliary tension functional as well as organic factors must be considered. Indeed, the evidence in this case and in many of those in the literature appears to support the contention that biliary obstruction caused by a functional spasm of the sphincter mechanism may elevate intraductal tension sufficiently to produce a rupture at a weak point in the biliary canal.

One of the interesting features of the case was the persistence of brown stools throughout the illness and the cessation, upon two separate occasions, of external biliary drainage in the presence of a common duct stone. This could not have occurred with complete

organic obstruction. The added and possibly determining obstructive factor in the causation of rupture was an intensely irritable sphincter. Even following choledocholithotomy this patient displayed roentgenographic kymographic and biochemical (pancreatic reflux) evidence of increased sphincter tone. Colp^{30, 31} has repeatedly emphasized the importance of this increased tonus and irritability of the sphincter in the production of biliary dysfunction and pancreatic disease. It is also significant that this patient had been receiving large doses of morphine for pain during attacks of colic. Morphine alone may cause intense spasm in an irritable sphincter. The logical sequence of events in the case presented appears to be organic obstruction caused by stone and abetted by a secondary functional spasm of the sphincteric mechanism leading to an increase in intraductal pressure sufficiently great to cause rupture at the point of least resistance, i.e., the site of previous choledochostomy.

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It was considered advisable to continue T tube drainage for ten weeks more. At the end of this time on May 1, 1946, x ray study of the biliary tract with and without morphine²⁷ showed slight persistent sphincter spasm. Kymographic study of the sphincteric resistance²⁷ confirmed this, the initial resistance of the sphincter being 150 mm. of water and the resistance one hour after six minims of Magendie solution being 300 mm. of water. Nevertheless the T tube was removed at this time, just six months after choledocholithotomy. Follow up six months later has shown no indication of persistent disease.

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cases of recurrent choledocholithiasis—especially in those with an irritable sphincter Morphine as an analgesic should be avoided when ever possible in the postoperative period of biliary surgery

SUMMARY

A case is presented of spontaneous postcholedocholithotomy choledochal rupture The literature, etiology and prevention of this surgical complication are discussed Mechanical and functional obstruction are stressed as causative factors The surgeon is cautioned against the overuse of morphine in biliary surgery

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A RARE ANOMALY OF THE CYSTIC DUCT

H E LEITER, M D, F A C S *

THE purpose of this presentation is to describe an instance wherein the cystic bile duct emptied into the right hepatic duct. Under ordinary circumstances, this abnormality would be purely of anatomical interest. In this case, however, the presence of the anomaly increased the difficulty of the operative procedure.

CASE REPORT

History — J L was a 50 year old male who entered the hospital July 24, 1944. He was well until six months prior to admission when he noted the onset of slight nausea and a bloated feeling in the epigastrium after meals. About two weeks before hospitalization some vague abdominal discomfort developed which was soon followed by jaundice, dark colored urine, anorexia and constipation. He had lost approximately ten pounds in weight.

Physical Examination — There was no evidence of ascites and the superficial abdominal wall veins were not prominent.

Laboratory Data — Urinalysis was normal except for the definite presence of bile. The hemoglobin content of the blood was 77 per cent (Sahli) and the white

cephalin flocculation test was first reported as being 1 plus but later became 4 plus. The stools were negative for blood on chemical examination. Gastrointestinal

Findings — There were extensive adhesions between the liver and diaphragm which obliterated the right subphrenic space. The gallbladder was moderately distended with thick greenish yellow bile. The cystic duct entered the distal por

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Physical Examination—The patient was thin, moderately icteric and appeared chronically ill. No abnormality could be found on examination of his heart, lungs or blood pressure. The abdomen was soft, slightly scaphoid in appearance and palpation of the right upper abdomen revealed an enlarged, nontender liver which extended about 4 cm. below the costal margin. The gallbladder could not be felt. There was no evidence of ascites and the superficial abdominal wall veins were not prominent.

Laboratory Data—Urinalysis was normal except for the definite presence of bile. The hemoglobin content of the blood was 77 per cent (Sahli) and the white

cephalin flocculation test was first reported as being 1 plus but later became 4 plus. The stools were negative for blood on chemical examination. Gastrointestinal studies were essentially normal.

duct. Right and left hepaticoduodenostomy with complementary jejunostomy for alimentation was carried out.

Findings.—There were extensive adhesions between the liver and diaphragm which obliterated the right subphrenic space. The gallbladder was moderately distended with thick greenish yellow bile. The cystic duct entered the distal por

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hours. After this, jejunostomy feeding was carried out until oral alimentation was permitted on the fourth day. Within a few hours after operation bile was noted in the material that was aspirated from the stomach through the indwelling Levin tube. On the fifth postoperative day, some biliary drainage was noted on the dressings and thus persisted for sixteen days. The icteric index dropped to 15 by the sixth day after operation and a week later was down to 6. A secondary anemia was combated by the administration of blood. The patient was discharged from



Fig 171—Photograph showing the common bile duct, the position of the carcinoma within the common duct, segments of right and left hepatic ducts, and portion of the cystic duct

the hospital four and one half weeks after operation weighing 112½ pounds as compared with a preoperative weight of 113 pounds

Pathology. Gross—The specimen consists of a gallbladder to which is attached

mass within the common bile duct which measures about 1 cm in length and almost completely obliterates the lumen (Fig 171). The mass on section is grayish

tion of the right hepatic duct. The latter was approximately 1.25 cm in diameter while the left hepatic duct was almost 2 cm in diameter. Just distal to the junction of the two hepatic ducts, there was a hard tumor mass about 1 cm in diameter which was situated within, and completely obstructed, the common bile duct. Distal to this tumor, the common duct appeared normal in caliber. There were no evidences of metastases in either the liver or in the region of the portal fissure. The tumor mass was not adherent, but the common bile duct was covered by a number of small blood vessels and bands.

Procedure.—A right upper rectus muscle-splitting incision was used. After separating the adhesions, it was felt that the lesion was a carcinoma of the common bile duct and that it could be removed. The distal portion of the choledochus was exposed after ligating and severing the numerous overlying vessels and bands. A temporary loop was then thrown around it. The proximal portion of the common duct and tumor were then freed from the surrounding structures. In order to clarify the position of the cystic duct, the gallbladder was removed from the liver bed subserosally from above downwards and the cystic vessels were ligated and cut. The cystic duct was then liberated to its termination which was found to be in the lower portion of the right hepatic duct. Since the carcinoma was situated almost at the junction of the two hepatic ducts, it was necessary to cut through each hepatic duct separately. After severing the common duct below the neoplasm, the specimen was removed with the attached gallbladder and cystic duct. The cystic duct entered the right hepatic duct about 5 mm proximal to the point of junction of the two hepatic ducts. The distal end of the common duct was doubly ligated with chromic catgut. Each hepatic duct was then separately united with the second portion of the duodenum using interrupted No. 000 chromic catgut sutures for a two layered anastomosis with small rubber tube splints. The two anastomoses were about 0.75 cm apart. The duodenum was attached to the liver capsule with several interrupted sutures. Because it was felt that duodenal rest would be advisable, a Stamm Kader type of jejunostomy was done about 16 inches distal to the duodenojejunal junction and the tube was brought out through a left lateral stab incision. Two Penrose drains were placed down to the anastomosis and the abdomen was closed in layers with chromic catgut. Several heavy silk sutures through all the layers of the abdominal wall were used in addition, for reinforcement.

The patient received 500 cc of citrated blood during the operation.

Postoperative Course.—The patient's condition was satisfactory at the end of the operation and intravenous fluids were administered for the first twenty four

an early bifurcation of the primary duodenal bud into right, left and cystic ducts with the cystic duct originating so low down as to arise from the right hepatic duct

SUMMARY

An unusual anomaly was described wherein the cystic duct entered the right hepatic duct. This complicated the surgical procedure of resection of a common bile duct carcinoma, and necessitated a separate right and left hepaticoduodenostomy.

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in color and invades the wall of the duct. The gallbladder is filled with thick greenish bile. The cystic duct appears to enter the right hepatic duct about 4 mm. above the point of junction of the two hepatic ducts.

Microscopic sections reveal the growth to be an adenocarcinoma.

Follow Up.—Several weeks after leaving the hospital the patient began to have recurrent episodes of chills, fever and icterus. Hospitalization was advised but he refused. These attacks became more frequent and the patient's condition gradually deteriorated until he died at home nine months after operation.

COMMENT

A search of the literature reveals few references to this unusual anomaly. Klemperer and Otani have not seen this abnormality in a series of several thousand autopsy examinations. Graham and his associates in a liberal description of the various extrahepatic duct anomalies fail to mention the above described condition. Eisendrath's series of 100 cases does not disclose a similar example. Flint's study of 200 postmortem examinations reveals twenty nine instances of an accessory right hepatic duct. Most of them entered various parts of the common hepatic duct except for one example in which it drained into the cystic duct. Lurje presented a series of 194 dissections of the biliary passages. In one case the cystic duct joined at the junction of the right and left hepatic ducts. The only reference that could be found to the anomaly seen in our patient is a drawing in the book by Boileau Grant.*

Embryologically, the extrahepatic ducts arise as an outgrowth from the foregut. The primary branch forms the common bile duct. In the normal development, an outgrowth from this duct becomes the cystic duct after which it bifurcates to form the right and left hepatic ducts. The portion of duct between the hepatics and the cystic duct is anatomically the common hepatic duct. A double primary outgrowth from the foregut may result in a duplication of the common duct, a separate duodenal entrance of a common bile duct and cystic duct, or an accessory hepatic duct. Since the primary outgrowth has the ability of forming branches, secondary ducts may develop. Thus accessory hepatic ducts may result from the choledochus, common hepatic duct, cystic duct, gallbladder, and right and left hepatic ducts. Early division of the common bile duct in the process of development may produce a condition whereby each hepatic duct extends down separately to a point close to the duodenum. Our anomaly must be explained on the probability of a primary outgrowth of the cystic duct from the right hepatic duct or

* A similar drawing has also been found in an article by Eisendrath.*

MODIFIED CHOLECYSTECTOMY IN FULMINATING CHOLECYSTITIS

L J MORSE M D, F A C S * AND J S BARB M D †

ONE of the fundamental principles which underlie the surgeon's ceaseless effort to make surgery safer is to correlate the extent of the operative procedure with the patient's ability to withstand it. Thus mortality must of necessity be the all important yardstick in determining the practicability of any operation.

Early cholecystectomy in acute cholecystitis has been finding increasing favor in recent years and a great majority agrees that this is the operation of choice. Unfortunately however many of these patients are not presented to the surgeon until their pathological process has advanced to a stage so severe that this procedure may impose an unwarranted risk.

In a comparative study of the operative mortality in the various stages of gallbladder disease from the clinic of the New York Post Graduate Hospital in 1939 Carter et al.¹ found that by dividing the types of acute cholecystitis into the following four pathological groups: acute, purulent, gangrenous and perforated the mortality ascends from 6 per cent in the first to 33 per cent in the perforated group. In other words increasing severity of the disease is accompanied by a mathematical progression in the mortality rate.

Where a less formidable procedure is indicated in the management of the advanced case of fulminating cholecystitis cholecystostomy has been accepted as the substitute for cholecystectomy in the interest of minimal trauma for the poor risk case. Thus both Walters and Cutler and Zollinger have found it expedient to perform cholecystostomy in approximately 20 per cent of their acute gall bladder cases. Cholecystostomy however does not appear to answer the problem since it is now recognized that this procedure gives

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mucosa attached to the liver bed—iodine, phenol or the actual cautery. This maneuver is entirely unnecessary, since in the type of case in which we have utilized this form of cholecystectomy, the necrotic mucosa readily sloughs away in the subsequent drainage. A catheter is placed in the patent cystic duct and a cigaret drain with its protruding gauze is so arranged in the gallbladder fossa as to aid in maintaining the catheter in situ. The abdomen is then closed.

The following are two illustrative case reports in which the operation of subtotal cholecystectomy was performed

CASE I—R. V., a 56 year old woman, was admitted to the Jewish Hospital of Brooklyn on September 30, 1934. She complained of ten attacks of right upper quadrant pain in the past two months. The last attack occurred ten days prior to admission and was followed by persistent soreness in the right upper quadrant. Physical examination revealed exquisite tenderness and spasm with a sense of mass in the right upper quadrant.

Exploration was carried out ten days after admission under nitrous oxide ether anesthesia. Upon liberation of dense pericholecystic adhesions, a gangrenous gall-

cystic duct. The stone could be removed only by splitting the gallbladder from fundus to cystic duct, thus joining both perforations. The wings of the gangrenous organ were removed, leaving the portion adherent to the liver bed in situ. A catheter was inserted in the cystic duct and fixed by placing one cigaret and one

good condition twenty four days postoperative with a small amount of biliary drainage and has remained well since this time.

CASE II—M. L., a 51 year old woman, was admitted to the Jewish Hospital of

ture to 104° F. The fever subsided with sulfa and penicillin therapy so that on admission the temperature was 100° F. Physical examination revealed tenderness and rigidity in the right upper quadrant, as well as a palpable mass extending three fingerbreadths below the costal margin.

Exploration was made on October 22, 1946, through a right upper rectus muscle retracting incision under cyclopropane curare-endotracheal anesthesia. The gallbladder was found to be gangrenous with a large calculus impacted in the cystic duct. This area perforated during gentle mobilization of the gallbladder. Subtotal cholecystectomy was performed in the manner described above.

rise to a decidedly higher mortality than does cholecystectomy. Carter reported 8 per cent mortality in 428 cholecystectomized patients with acute gallbladder conditions and 30 per cent in cholecystostomized patients. Neither poorer risk nor more severe diseased process could entirely account for this disproportionate mortality.

Our purpose here is to call attention to subtotal cholecystectomy which we believe is a procedure of inestimable value in the management of the acutely ill patient with fulminating cholecystitis. The gallbladder is removed to the cystic duct except for that portion attached to the liver bed. This procedure is by no means new. Reports have appeared in the literature since 1921. The largest studies reported are those of McKenty² in 1935, thirty-five cases with one fatality; Ritchie³ in 1937, twelve cases with no deaths; Estes⁴ in 1938, forty-eight cases with one death. The overall mortality for these three groups is just above 2 per cent. One of us (L. J. M.) did his first case in 1935. We now have a total of twelve cases without a mortality.*

INDICATIONS

The following have been our indications for the use of subtotal cholecystectomy:

1. The poor risk elderly patient too ill to withstand more than minimal surgery.
2. Advanced gallbladder disease of the gangrenous or perforated variety.
3. Gas gangrene of the gallbladder.
4. Carbunculosis of the gallbladder particularly as seen in the diabetic.

TECHNIC

Simplicity, gentleness and facility characterize the technic. After walling off the gallbladder the fluid contents are aspirated. An incision is then made from the fundus to the cystic duct and all stones virtually fall out. With the gallbladder split wide open stone removal is facilitated. Impaction plays no role in adding to the trauma. No attempt is made to isolate the cystic duct or artery in the brawny induration of the hepatoduodenal ligament. Now both redundant rings of the gallbladder are trimmed off at the liver bed attachment. Bleeding from the cut edges is controlled by suture ligation. Various agents have been utilized for application to the residual gallbladder.

* From the Surgical Services of Queens General Hospital and the Jewish Hospital, New York.

mucosa attached to the liver bed—iodine, phenol or the actual cautery. This maneuver is entirely unnecessary, since in the type of case in which we have utilized this form of cholecystectomy, the necrotic mucosa readily sloughs away in the subsequent drainage. A catheter is placed in the patent cystic duct and a cigaret drain with its protruding gauze is so arranged in the gallbladder fossa as to aid in maintaining the catheter in situ. The abdomen is then closed.

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good condition twenty four days postoperative with a small amount of biliary drainage and has remained well since this time.

CASE II—M. L., a 51 year old woman, was admitted to the Jewish Hospital of Brooklyn on October 20, 1946. Her first attack of right upper quadrant pain occurred one year before. Six days prior to admission the patient suffered her second attack of biliary colic associated with profuse vomiting and a rise in temperature. Penicillin therapy so that on physical examination revealed tenderness well as a palpable mass extending

Exploration was made on October 22, 1946 through a right upper rectus muscle retracting incision under cyclopropane curare-endotracheal anesthesia. The gallbladder was found to be gangrenous with a large calculus impacted in the cystic duct. This area perforated during gentle mobilization of the gallbladder. Subtotal cholecystectomy was performed in the manner described above.

The patient had an uneventful postoperative course, except for a mild febrile rise due to a wound infection on the ninth day. She was discharged on her thirteenth postoperative day with a slight amount of biliary drainage.

MERITS OF THE OPERATION

The remarkably low mortality merits our consideration

1 The exposed gallbladder bed is a fertile source for bile leakage from accessory bile ducts, as well as blood seepage from opened vascular spaces. Detachment of this intimately adherent acutely inflamed gallbladder exposes these open channels to the ingress of infection, especially is this true when we realize that in removal, trauma further devitalizes the tissues. In many of these cases with pericolecystic abscess formation, cleavage planes are completely obscured so that any attempt to remove the adherent gallbladder entails digging it out of the liver. The above technic precludes disturbing nature's protective barriers and does not open new avenues for the spread of infection into the liver, which already carries so heavy a burden in this disease. This factor is the basis of Thorck's⁵ operation of cholecystectomy with electrocoagulation. He applies it in all gall bladder cases, acute and chronic.

2 Unlike cholecystostomy, the gangrenous or carbunculous organ is not left behind as a continued focus of infection. This is most important not only in mortality, but in morbidity results.

3 When cholecystostomy results in the patient's death, it is difficult to escape the conclusion that the trauma and manipulation involved in liberating a tightly impacted stone in the cystic duct, undertaken through a limited vent in a deeply seated gallbladder, must of necessity have played a serious role in the fatal outcome. Such trauma and stirring up of the infectious process is completely avoided by splitting the gallbladder wide open. The contents are immediately liberated. Access to the cystic duct is facilitated.

4 Cystic duct drainage exerts a beneficial influence by decompressing the infected biliary tract.

5 Secondary operative intervention to remove the diseased gall bladder is obviated. Estes⁴ reported four cases personally reoperated for residual common duct disease. Dense adhesions over the gall bladder fossa were found, but no vestige of anything resembling a gallbladder was seen. These observations together with clinical experience give cogent testimony to the effectiveness of subtotal cholecystectomy.

CONCLUSIONS

Classical cholecystectomy is still the operation of choice in the treatment of gallbladder disease and in no wise should subtotal cholecystectomy be considered to supplant it. However, when com

plete removal cannot be safely accomplished, partial cholecystectomy rather than cholecystostomy, should present itself for the surgeon's consideration. It combines all the advantages of cholecystectomy with none of the drawbacks of cholecystostomy, and in addition, escapes the added risk of formal cholecystectomy.

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RADICAL OPERATIONS ON THE HEAD OF THE PANCREAS

WILLIAM BARCLAY PARSONS, M.D., F.A.C.S.*

RADICAL operations on the pancreas, in which part or all of the organ is removed, have been performed so many times in different parts of the country that they are now an accepted surgical procedure. They are indicated occasionally in hypoglycemic states where the diagnosis of islet tumor has been made but no definite tumor can be found, in pancreatolithiasis with intractable pain, in carcinoma of the pancreas and in tumors of the ampullary region.

Those operations in which the head of the pancreas is removed involve duodenectomy and a series of anastomoses. These are formidable operations performed usually on debilitated patients who may be jaundiced. Twelve years ago, when the first two stage operation was done, the first stage included short circuiting of the bile to remove the hazards of doing a major operation on a jaundiced patient. Since that date, advances in preoperative and postoperative care, in operative technique, and the use of vitamin K have made it possible to do the operation in one stage, thus avoiding a second anesthesia and the greater difficulties due not only to the adhesions produced at the first operation but also to the handicap imposed in exposure because of the biliary system short circuit previously effected.

The one-stage operation has been made possible by the increased availability of blood and blood substitutes, greater knowledge of the importance of protein, a better understanding of fluid balance mechanisms, the introduction of vitamin K, greater facility in the use of fine silk, and modern methods of anesthesia. During operations lasting four hours, in which considerable trauma is caused to branches of the celiac plexus, which may be associated with considerable loss of blood and which at best are shocking, anesthesia must be in the hands of an expert who has selected the anesthetic best suited to the particular patient, and who is constantly aware of slight curate dissecting ability and of tissue damage and permit obviate leakage of pancreatic fluid which, when activated, may have devastating effects. Vitamin K

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increases the coagulability of the blood and reduces the danger of oozing, formerly so dangerous in jaundiced patients. Shock, whether immediate or delayed, hypoproteinemia, electrolyte imbalance and disturbances in the relationship between blood volume and intracellular and extracellular fluid present problems in preoperative and postoperative supportive therapy that must be correctly solved.

PREREQUISITES TO SUCCESSFUL OPERATION

Before one of these operations is undertaken, certain conditions must be met by the operating surgeon. A casual acquaintance with the anatomical relationship of the posterior aspect of the pancreas is not sufficient. The operator must know where he is at all times and what structures he will encounter next. To insure adequate anatomical knowledge, he should refresh his mind by dissections in the anatomical laboratory before assuming the responsibility of one of these hazardous operations. After careful dissections of the region the operator, before doing his first case, should first carry out a completed operation in the dissecting room. He will then have a reasonably clear idea of the several steps in the procedure and the anatomical problems to be overcome in each of these steps. Even with a clear mental picture of the relationships he must be an accurate careful dissector. The portal and splenic veins, the superior mesenteric and celiac vessels are structures which must not be sacrificed. The splenic artery is necessary for viability of the tail of the pancreas and the spleen.

Anatomical knowledge and dissecting skill are prerequisites in the operator, but to give them full play he must provide adequate exposure and perfect hemostasis. He must in addition have a well trained team, not only at the operating table but also in the ward, that will function smoothly and will know not only how to furnish preoperative preparation and postoperative supportive therapy, but also what tests are necessary to indicate changes in physiological balance, and how to forestall or treat complications. Close liaison with a reliable laboratory that will report the results of the various tests promptly and accurately enables one to institute indicated measures before processes become irreversible.

ISLET CELL ADENOMA WITH HYPOGLYCEMIA

The diagnosis of hypoglycemia due to hyperinsulinism from a hyperfunctioning adenoma of islet tissue will be based on the tradition laid down by Whipple, namely (1) attacks of nervous or gastro

intestinal disturbance coming on in the fasting state, associated (2) with a hypoglycemia below 50 mg per 100 cc. of blood, which (3) are relieved immediately by the ingestion of glucose. Operation is indicated in patients presenting this triad, but occasionally no adenoma can be recognized after inspection of the entire organ. Resection of the body and tail to the left of the superior mesenteric vessels with splenectomy is then indicated, in the hope that removal of the major part of the organ may include one or more buried impalpable tumors, with the knowledge that enough islet tissue is left to prevent the development of diabetes, but admitting the possibility that the tumor may be left behind. This is of course a choice between two evils but it is better to resect only part rather than the entire organ, and the selection of the less severe operation is preferable. Moreover, the head may be resected later if necessary in those cases that present continuing symptoms.

PANCREATOLITHIASIS

Pancreatolithiasis, usually in the head, sometimes in the entire organ, and but rarely limited to the tail, may follow acute pancreatitis. The process seems to start with the formation of calculi in the main ducts, but in severe forms, with extreme fibrosis throughout the parenchyma, deposits of calcium may be present throughout the finer ducts. The islands of Langerhans escape inclusion in the process, therefore diabetes is not produced and the islet tissue on section has been well preserved. Intractable pain radiating to the back is the one symptom of importance. This pain is so severe that morphine addiction has commonly been a major associated problem. Operation to relieve this incapacitating pain and to cure or forestall drug addiction is welcomed by the patients.

The diagnosis is based on x-ray evidence and the history of a previous attack of pancreatitis followed by the development of severe pain after a lapse of time which may be several years. The pain is upper abdominal radiating through to the back and becomes excruciating, requiring large doses of morphine. The x-ray film will show calcification in the region of the pancreas, either in part or throughout the organ. Duodenal drainage usually shows diminution of pancreatic ferments often of marked degree. The serum amylase may be somewhat elevated, but with atrophy of acinar cells there is
patients not
, as the islet

Resection of the involved portion is the indicated treatment. The risk is of course formidable, but does not compare with the risk associated with resection for carcinoma. Five partial resections have been done at the Presbyterian Hospital without fatality, and two total pancreatectomies with one death, but this is too small a series to be significant. However, it is worth noting that these patients with calcification are apt to be younger than those with carcinoma, have not been jaundiced and therefore have not suffered liver damage with its attendant interference with sugar and protein metabolism. Although they have been in pain there has not been the nutritional disturbance so characteristic of the cancer patient. The details of the operation are similar to those for carcinoma, and will be discussed later.

Even though the lithiasis may be limited to the head there is always some degree of chronic fibrosis in the tail. For the sake of preservation of islet tissue it is best to leave a fibrotic body and tail not obviously involved in calcification, admitting the possibility that symptoms may arise in the future necessitating the subsequent removal of the body and tail. This conservative attitude avoids the production of total diabetes and in the cases operated on to date has been justified.

CARCINOMA OF THE HEAD OF THE PANCREAS

Carcinoma limited to the body and tail of the pancreas seldom produces symptoms early enough to make successful resection feasible. Cachexia and metastases are the rule in these cases, so that some palliative operation is all that can be done. Carcinoma of the head, starting near enough to the ampullary region to cause early jaundice, lesions of the papilla of Vater, and those of the duodenum in the ampullary region blocking the common duct, form a group of cases usually indistinguishable diagnostically that present similar therapeutic problems. The only difference between them is in the occasional case of carcinoma of the head that has extended, without obvious metastases, so far into the body of the pancreas as to make total pancreatectomy necessary. In all other cases the operation necessary is duodenectomy and resection of the pancreatic head. Of these carcinoma of the papilla which causes early jaundice is apt to be the most limited in extent and therefore has the best prognosis for relief of symptoms. Cure is another matter. The first one stage operation done by Whipple in 1940, on a patient with a nonfunctioning carcinoma of islet tissue causing jaundice, is alive and comfortable six years later, but presents an enlarged nodular liver unquestionably

due to metastases. She has, however, had at least this prolongation of life in comfort.

Diagnosis.—Diagnosis lies between the various conditions associated with jaundice, as the latter is the symptom bringing the patient for treatment. Contrary to the teaching of former years, there is frequently pain, so the immediate assumption that cholelithiasis is present must be avoided. A history of gallbladder disease with stones may be most confusing. The jaundice is obstructive and not due to intrahepatic disease, therefore the alkaline phosphatase will be elevated and the cephalin flocculation test will be negative. Duodenal drainage will show an absence of bile and lowered pancreatic ferments when there is only one pancreatic duct and this is blocked. When both Santorini and Wirsung ducts are present there may be no drop in ferments. Microscopical examination of the duodenal fluid will not show bilirubin or calcium crystals but may show red blood cells if an ulcerated lesion is present. Radiological evidence is seldom significant, although occasionally an enlarged pancreatic head will alter the shape of the duodenum and at times ulceration in the ampullary region will distort the outline as seen in a lateral view of the duodenum. Differential diagnosis between carcinoma of the head and chronic pancreatitis sufficiently extensive to cause jaundice may be impossible. Usually in the latter there is a previous history that is suggestive, particularly with intermittent jaundice, but even at operation the diagnosis is often difficult because a biopsy may not include the tumor. Fortunately such instances are rare, but they do occur and do add to the responsibility resting on the surgeon. All he can do is to follow his best judgment in each individual case.

Surgical Treatment.—Surgical therapy consists of three phases, no one of which may be safely treated lightly. Preoperative preparation, the details of the operation, and postoperative support are each of vital importance.

Preoperative Preparation.—As complete an analysis as possible must be made of the circulation of the individual. This includes cardiac adequacy, electrolyte and protein balance, blood volume and clotting power. Electrocardiogram, prothrombin content, chloride concentration and complete protein and nitrogen analyses are indicated. Estimation of the blood volume in severe jaundice is still difficult but is important, particularly in the postoperative period. Vitamin K must be administered to reduce the clotting time. Repeated blood transfusions and a high vitamin, high protein, high carbohydrate diet will increase the protein and glycogen reserve. If the taking of food is in-

adequate, intravenous glucose and vitamins must be provided. The hematocrit and serum protein determination by specific gravity should be done but these tests do not give a complete picture of the status with respect to circulating and extracellular fluid. Blood volume studies in addition help to determine the preoperative base line of the state of circulation using that term in its complete scope.

The Operation—The operation itself is a complicated one of dissection, resection and reconstruction. The incision should be long enough and so placed as to give easy access without the necessity of using forcible retraction. A slightly curved long transverse incision is necessary for the exposure of the entire pancreas. Through this incision splenectomy and resection of the body and tail, with or without removal of the head can be done with complete visualization of the entire organ. For operation on the head alone a long right rectus incision furnishes adequate exposure and is less time consuming than the long transverse one. An infusion of glucose and saline should be running before the incision is made. As soon as it has been decided that a radical operation is to be done transfusion of blood should be substituted for the infusion and should be maintained throughout the operation at least 1000 cc and preferably 1500 cc being administered.

If the operation is limited to removal of the body and tail the pancreas is exposed by division of the gastrocolic omentum. Splenectomy is done and the inferior margin of the body and tail of the pancreas is freed from the tip of the tail across in front of the inferior mesenteric vein, exposing the junction of this vein with the splenic vein. The splenic artery which runs along the superior border of the pancreas is ligated at the desired point of section and the splenic vein is divided and tied distal to its junction with the inferior mesenteric vein. The pancreas is cut through in a wedge shape and the raw surfaces are approximated with interrupted sutures of fine silk. A sump drain consisting of a small catheter within a rubber tube is placed to the denuded area and the abdomen is closed. If the entire pancreas is to be removed after the body and tail have been mobilized and the splenic artery and vein ligated the head is then removed.

In removal of the head of the pancreas there are certain anatomical difficulties which can be circumvented by following a definite series of steps. The portal vein and superior mesenteric vessels with their branches must be preserved. The lingula or uncinate process arising from the lower portion of the head runs behind these structures and when well developed presents serious difficulties in dissection. The middle colic artery usually arises from the superior mesen-

tense at a comfortable distance below the pancreas, but may arise higher and occasionally forms a common trunk with the inferior pancreaticoduodenal artery. The lower part of the common duct may be closely applied to the portal vein, and the anterior surface of this vein may be intimately attached to the posterior surface of the pancreatic head when there has been extensive fibrosis or malignant invasion. Each step is designed to afford exposure of one of these vessels at a safe point. When exposure has been accomplished of as many as possible of these safety points, the most difficult area can then be attacked with greater assurance.

In the absence of liver metastasis one cannot be certain of operability until one has determined the absence of direct extension posteriorly. This cannot be determined until the first step is completed, so radical removal is then commenced according to the following steps:

- 1 Mobilize the entire duodenum and head of pancreas by incision of the parietal peritoneum lateral to the duodenum. This mobilization should expose the vena cava, terminal common duct, the lateral surface of the portal vein and the posterior surface of the superior mesenteric vessels. Operability can now be determined and the operation is then concluded by some palliative procedure or is continued as follows:

- 2 Ascertain the relationships of the uncinate process to the superior mesenteric vessels. It may be convenient to ligate the inferior pancreaticoduodenal vessels at this time and to start freeing the uncinate process, both posteriorly and from the superior mesenteric vessels.

- 3 Isolate and divide the common duct far enough below the cystic duct to leave a convenient cuff for anastomosis. With a very low cystic duct it may be necessary to do a cholecystectomy. Begin the freeing of the portal vein so that the terminal part of the splenic vein can be seen.

- 4 Division of the stomach between clamps a convenient distance from the pylorus is then done. It may or may not be convenient to divide and ligate the gastroduodenal and pyloric arteries before division of the stomach, but eventually they must be divided and ligated. Now the upper margin of the head of the pancreas can be further liberated from the portal and splenic veins.

- 5 If the inferior pancreaticoduodenal vessels have not already been attended to they are ligated and divided, and the intestine is now to be divided to the left or the right of the angle of Treitz, depending upon the type of subsequent anastomosis desired, whether

with a long loop or by a straight jejunal limb. If the latter, the jejunum is sectioned at a convenient point below the angle, both ends are closed and, after control of the vessels, the proximal end is pulled through beneath the superior mesenteric vessels, whereas if a long loop is to be used the duodenum is divided to the right of the vessels and both ends are closed. In either case the distal end is closed in layers, but the proximal end may be turned in rapidly with a purse-string suture, as it will shortly be removed with the specimen.

6 The splenic artery is exposed where it joins the pancreas on the upper margin of the neck, which completes identification of the landmarks around the part to be removed. The portal vein is cleared downwards, and the superior mesenteric vein upwards, from the posterior surface of the head. The splenic vein is identified lying across the beginning of the superior mesenteric artery and the pancreas is cut across. Further freeing of the uncinate process will allow removal of the specimen.

7 Reconstruction of the digestive canal is now undertaken, and will be antecolic with a long loop if the duodenum was divided to the right of the vessels, or postcolic with a straight limb if the jejunum was divided, the jejunal limb being brought up through a rent in the transverse mesocolon. The anastomoses to be completed are three in number, as follows:

(a) Choledochojejunostomy, end-to-side, using fine silk for the outer and fine chromic gut for the inner layer, at the apex of the loop or at a convenient point below the closed end of the jejunum. To avoid traction and strain on this suture line the jejunum should be anchored to the hepatoduodenal ligament above the anastomosis.

(b) Pancreatojejunostomy, end-to-side 3 to 4 cm. below the choledochojejunostomy. The capsule of the posterior half of the cut end of the pancreas is approximated to the serosa of the jejunum with interrupted sutures of fine silk. A catheter or gopher tube 15 cm. long that will fit the pancreatic duct snugly is selected and about 4 or 5 cm. of it is inserted into the duct and anchored with a single stitch of fine chromic gut. The free portion of the tube is inserted into the lumen of the jejunum through a small stab wound, no attempt being made to unite duct and jejunal epithelial linings. The anterior half of the capsule is then sutured to the jejunal serosa. In many cases atrophy of the pancreatic acinar cells has occurred so that there is but little external secretion, and therefore this anastomosis may not be strictly necessary. However there is usually some external secretion and it is wise to furnish connection with the intestinal tract.

(c) Gastrojejunostomy, end to side, at least 8 cm below the pancreatojejunostomy to avoid edema spreading from one anastomosis to the next, is then performed as usual. It is important that when a loop is employed the anastomoses be in the efferent loop and that the gastrojejunostomy be the most distal one in order to avoid the passage of gastric contents over the other anastomotic openings.

8 A sump drain consisting of a fenestrated rubber tube containing a catheter is placed to the denuded area so that by suction through the catheter the wound may be kept dry in the event that a pancreatic fistula develops. The wound is closed with silk and with figure-of-8 wire retention sutures in carcinoma cases. A nasogastric tube may be an important aid for two or three days postoperative to prevent gastric distention. These tubes are so irritating to the larynx after several days that I have used a gastrostomy tube in one case, and am considering the possibility of using a double lumen tube, such as the Ravdin tube, by means of gastrostomy through the gastrojejunostomy, for decompressing the stomach and for feeding into the intestine.

Postoperative Care—These are three to four hour operations which in the debilitated cancer patient are followed by a stormy postoperative course marked by varying degrees of shock. Early ambulation is seldom possible, gastric dilatation is frequently a problem, and the maintenance of fluid and protein balance is an extremely delicate matter. For the first two or three days after operation the fluid administered should consist of blood transfusion, 500 or perhaps 1000 cc, 5 per cent glucose, 500 cc, and one of the amino acid preparations such as amigen, 2000 to 2500 cc, making a total of 3000 to 3500 cc of fluid intravenously, and nothing by mouth. These fluids supply calories and protein insufficient for the body needs but adequate for the period. The enthusiasm of a few years ago for thorough hydration must be tempered with wisdom.

The carcinoma patients may have a total hypoproteinemia of marked degree, therefore they cannot handle large amounts of water and will have a tendency to extravasate into the tissues or the pleural or peritoneal cavities. In some respects they resemble the individuals with chronic starvation who perhaps have an increased cellular permeability but regardless of the mechanism concentrate their circulating blood as well as they can, meanwhile storing fluid in the extracellular compartments because of a total hypoproteinemia greater than is indicated by analysis of the serum in the circulating blood. It is vital to recovery that these patients be not overhydrated, and that sodium chloride be given in only small amounts.

Feeding by mouth with small amounts of water can be started on the second day while the nasogastric tube is still in place, and when danger of gastric dilatation has passed feeding by mouth can be continued as is done in cases of gastric resection. A complete fluid balance sheet must be started the day of operation indicating the amounts, kinds and route of administration and the amounts and routes of fluid output. Taking 1500 to 2000 cc. as the amount of incalculable fluid loss, one can then approximate the daily balance. Calories and grams of protein given should be calculated and charted. Feeding by mouth is still the most efficient way of furnishing calories, protein, salts and fluid, and therefore is the goal to be arrived at as soon as it is acceptable to the patient.

In spite of a high mortality rate—higher than 30 per cent in cancer cases and in the neighborhood of 10 per cent in lithiasis cases—the operation is worth the risk. It provides relief of intractable pain and drug addiction in the latter group and if it does nothing more at least prolongs life in reasonable comfort for those with carcinoma.

FACTORS INFLUENCING THE MANAGEMENT OF PANCREATIC CYSTS

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INCREASING experience with the poor results of external drainage (marsupialization) has taught that excision of pancreatic cysts is the treatment of choice. Where anatomical relationships make this hazardous, internal drainage (anastomosis of the cyst to a hollow viscus) is preferable, external drainage being reserved for cases where these procedures are impossible. The surgical procedure is limited by the location and relationships of the cyst, rather than its type. An exception to this generalization is the proliferation cyst, whose propensity for malignant degeneration makes excision especially desirable. Proliferation cysts have been treated by external drainage, followed by chemical agents or radiation to destroy the epithelial lining. This treatment is applicable to those which cannot be removed. However, in our cases it has not been utilized.

Excision is performed by establishing a cleavage plane between the capsule and the cyst wall around the base of the cyst. When this plane is opened, dissection proceeds bluntly until enucleation is complete. This dissection may be complicated by proximity to the common bile duct, portal vein or superior mesenteric vessels, or by the occurrence of adventitious vessels in the cyst wall. Chronic suppuration of a previously drained cyst may complicate the procedure, as well as present a debilitated patient for definitive surgery. Chronic pancreatitis may simulate carcinoma, disguise underlying pathologic change, and make diagnosis difficult. Interference with the external or internal secretions of the pancreas is a frequently reported complication of pancreatic cyst, but has not accompanied our cases preoperatively or postoperatively.

Six cases of pancreatic cysts in which operation was done during the past four years illustrate the difficulties associated with operation, as well as the factors influencing selection of the operative procedure.

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COMMON BILE DUCT OBSTRUCTION

Cysts arising from the head of the pancreas may extend posteriorly and compress the common bile duct. The duct may become intimately involved in the inflammatory reaction about the cyst wall, making separation tedious and duct injury likely. The conventional approaches through the gastrohepatic or gastrocolic ligaments are not applicable here, as mobilization and rotation of the duodenum to the left afford the safest exposure of the cyst and bile duct.

CASE I—P. K., a 40 year old man, was admitted to the New York Post Graduate Hospital, February 17, 1944 complaining of generalized itching for three

at the abdomen. There was pruritus of the skin and mucous membranes. Sigmoidoscopic examination was negative.

All laboratory studies were normal except for anicterus index of 24.2. Cholecystogram failed to visualize the gallbladder but showed a soft tissue mass in the right upper quadrant. A gastrointestinal roentgenogram and barium colon enema were normal. Duodenal drainage obtained concentrated bile.

the head of the pancreas were mobilized and rotated to the left, exposing a grayish cystic mass in the head of the pancreas intimately attached to and compressing the common bile duct. After aspiration the capsule was incised about the base of the

enlarged duct above the opening which was closed with interrupted sutures.

The pathologic report was pseudocyst of undetermined origin.

The patient was discharged on April 5, 1944 after an uneventful convalescence. Follow up examinations at yearly intervals have found him in good health with no recurrence of his symptoms.

PORTAL VEIN OBSTRUCTION

This structure may be obstructed by cysts occurring in the neck and head of the pancreas. Chronic obstruction results in extensive collateral circulation with the posterior abdominal veins producing distended tortuous friable veins over the posterior abdominal parietes. Such collateral vessels may make excision hazardous owing to the likelihood of uncontrollable hemorrhage and constitute an indication for internal drainage of the cyst.

CASE II—M. C., a woman aged 33 was admitted to the New York Post Graduate Hospital May 29, 1946 complaining of epigastric pain radiating to the

back for three years. Two years previously a cholecystostomy and external drainage of a pancreatic cyst had been performed elsewhere. Postoperatively she had done poorly and remained in the hospital for six months. In March 1945 her symptoms recurred, so that cholecystostomy and external drainage were again performed. Since that time the drainage site had opened and closed intermittently, and her symptoms had persisted. During her illness her weight had dropped from 100 to 72 pounds.

Physical examination showed a chronically ill, undernourished woman. There were two well healed operative scars in the right upper quadrant. There was deep tenderness in the right upper quadrant and rebound tenderness was referred to this area.

Laboratory studies were negative except for a moderate secondary anemia.

Operation was performed June 4, 1946. A cystic mass was found in the head of the pancreas, obstructing the portal vein. There were many dilated collateral

creas were mobilized and rotated medially to identify the pathology. The cyst was opened and its nature determined by the absence of a lining membrane grossly, and by frozen section. An attempt to mobilize the cyst was made, but its adherence to the common duct resulted in a small tear in that structure. The large drainage was anastomosing tube without evi-

dence of tumor or epithelial lining.

Convalescence was uneventful, except for prolonged biliary drainage. She was discharged on July 28, 1946, and has gained weight and been symptom free since that time.

INFECTION OF PREVIOUSLY DRAINED CYST

Patients who have had repeated external drainage of pancreatic cysts present the problem of controlling infection before a definitive procedure is performed. They may be in poor condition due to chronic suppuration, and require further drainage of the cyst before excision. The protracted disability of patients managed by external drainage is a strong argument against that form of treatment if it can possibly be avoided. This is especially true with proliferative cysts whose epithelial linings must be destroyed.

CASE III—M. D. A woman aged 34 was admitted to the New York Post

that time six incisions and drainage of the cyst had been necessary. Her general condition had deteriorated, and she had had a severe pneumonia in January 1942 with a right pleurisy, which had cleared with aspirations.

Physical examination showed a chronically ill woman. There was edema of the eyelids and ankles. The blood pressure was elevated to 200/130, and tachycardia was present. The left upper quadrant of the abdomen was entirely filled by a large tender mass.

Laboratory studies showed a secondary anemia and leukocytosis. Albumin and red blood cells were present in the urine. The serum protein determination was 5 per cent, with a serum albumin of 2.5 per cent, and an albumin globulin ratio of 1. The electrocardiogram was suggestive of hypertension.

After preparation by multiple transfusions, incision and drainage was performed on July 2, 1942. A large cavity was found containing purulent, necrotic material. Following this procedure her condition improved, and on July 24, 1942, laparotomy was performed. A cyst 20 cm. in diameter was found arising from the body of the pancreas, and adherent to the stomach and transverse mesocolon. The lesser sac was entered through the gastrocolic omentum and a circular incision made around the base of the cyst. A cleavage plane was developed and the dissection carried posteriorly until two large vessels were found on either side of the cyst. These proved to be the superior mesenteric artery and vein. They were separated from the cyst wall without incident, and the enucleation completed.

Pathologic report was multilocular cyst of pancreatic origin, proliferative type.

Postoperative convalescence was uncomplicated and the patient was discharged from the hospital on August 13, 1942. Since that time yearly follow up examinations have found her in good health, with no complaints referable to her illness. The signs of impaired kidney function cleared and there are no residual evidences of a chronic nephritis.

HEMORRHAGE DUE TO ADVENTITIOUS VESSELS

Two patients in this series had large vessels in the capsule of the cyst, causing troublesome hemorrhage after enucleation. These occurred with a multiloculated proliferation cyst and a large pseudocyst. The vessels entered the posterior portion of the capsule and were not encountered until the cyst had been completely removed. When the vessel could not be clamped, hemorrhage was controlled by suturing the capsule over a gauze packing. The absorbable hemostatic agents now available could be used in this situation to great advantage.

CASE IV—A woman aged 41 was admitted to the New York Post Graduate Hospital, November 11, 1945, complaining of fatty food intolerance for three years. One year previously she had discovered a mass in her right upper quadrant. She was informed elsewhere that this was an enlarged gallbladder and a diet was prescribed. On the diet her digestive symptoms diminished and she lost 20 pounds. Two months before admission she had an attack of severe lumbar back

upper quadrant of the abdomen.

Laboratory studies were normal except for gastrointestinal roentgenograms which showed a large epigastric mass corresponding in location to the head of the pancreas.

At operation performed November 14, 1945 a multilocular proliferative cyst was found in the head of the pancreas. This projected through the gastrocolic omentum and displaced the duodenum to the right. The capsule was incised about the base of the cyst. Enucleation then proceeded with some difficulty because of the multiple loculations of the cyst, each of which had to be separated from the fibrous capsule. A persistent oozing in the pancreatic bed was controlled by suturing the fibrous capsular wall over a gauze packing.

Pathologic report showed a multilocular proliferation cyst.

Postoperative convalescence was uneventful. The packing was removed under cyclopropane anesthesia on the thirteenth postoperative day.

Follow up examination nine months after operation found the patient symptom-free and without abnormal abdominal findings.

CASE V—A man, 64 years old, was admitted to the New York Post-Graduate Hospital September 21, 1945, complaining of a mass in the right upper quadrant of the abdomen for five years. This had remained the same size until three weeks before admission, when it began to enlarge rapidly.

Physical examination showed a large, globular, protruding, non tender mass filling the right upper quadrant of the abdomen and the epigastrium.

Laboratory studies were negative, including serological tests for amebiasis and echinococcus infection.

Operation was performed September 28, 1945. A pseudocyst was found arising from the head of the pancreas, completely filling the upper abdomen. On aspiration 2500 cc of bloody fluid was obtained. After collapse of the sac an incision was made through the cyst capsule near its base and a cleavage plane established about its entire circumference. The cyst was then shelled out without difficulty. One

The cavity was then loosely packed with gauze, and the fibrous margins of the capsule sutured over the packing.

Convalescence was uneventful except for a transitory left hemiparesis, which was probably of vasospastic origin, as it cleared in twenty four hours. The packing was removed under cyclopropane anesthesia on the fourteenth postoperative day.

The pathologic report was hyalinized cyst wall, without evidence of epithelial structures.

At follow up examination one year after operation there were no symptoms referable to the abdomen, and physical examination was negative.

CHRONIC PANCREATITIS

This is a common accompaniment of benign intra-abdominal processes, and may be difficult to differentiate from carcinoma before and during operation. In its presence deep pathology in the pancreas is difficult to palpate and evaluate. Biopsy is not always satisfactory, and radical procedures may be unwittingly performed for benign conditions.

CASE VI—M. A., a man, aged 56, was admitted to the New York Post-Graduate Hospital, August 13, 1944, complaining of epigastric pain and distress, with a loss of 41 pounds in eighteen months. These symptoms occurred after meals and at night, but were not affected by food or alkali. The stools had occasionally been clay colored, but no jaundice had ever been noticed. Vomiting was associated with the pain on rare occasions, but the patient's appetite remained good.

On physical examination there was tenderness in the right upper quadrant and epigastrium. No mass could be palpated.

Gastrointestinal roentgenograms showed a deformity of the descending portion of the duodenum that was thought to be a carcinoma of this portion of the duodenum. Cholecystograms were normal.

Operation was performed on August 16, 1944. A hard nodular mass 10 cm. in diameter was found in the head of the pancreas. This was at first considered inflammatory because of the extensive subserous edema noted anteriorly. However, after mobilization of the duodenum, the posterior aspect of the mass was found to be grossly typical of carcinoma, so that pancreaticoduodenectomy was performed.

The operative procedure was well tolerated. The patient, however, did poorly postoperatively, and died on the fifth postoperative day.

Necropsy showed diffuse acute suppurative peritonitis, subphrenic abscess and fat necrosis of the pancreas.

On pathologic examination of the operative specimen, a retention cyst 4 cm. in diameter was found in the head of the pancreas. There was an associated chronic fibrosing pancreatitis. The submucous layers of the duodenum were involved in the diffuse inflammatory process.

SUMMARY

Six cases of pancreatic cyst are reviewed from the standpoint of factors influencing the operative procedure. Whenever possible excision is favored. Of this group, excision was possible in one case with common bile duct obstruction, one case with an infected cyst cavity, two cases with large adventitious vessels in the capsule, and one case of severe chronic pancreatitis. Internal drainage had to be resorted to in a pseudocyst which obstructed the portal vein and caused numerous dilated venous channels. Chronic pancreatitis is cited as a misleading complication, as it masked a retention cyst and simulated carcinoma so closely that pancreaticoduodenectomy was performed. This patient was the only fatality of this group.

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SYMPOSIUM ON PEDIATRIC SURGERY

THE SURGICAL CORRECTION OF CONGENITAL CLEFT LIP

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The purpose of this paper is to consider the problems that must be overcome in correcting the deformities of congenital cleft lip. The scope of this discussion does not permit a consideration of the many different methods that have been used and suggested, but only certain of those procedures that have proved their worth.

Congenital cleft lip is the result of failure of union in early embryonic life between the processes that form the lip, and the alveolar border. The degree of deformity may range from a notched vermilion border of the lip on one side, to failure of union between all the various processes thus producing a complete bilateral cleft lip. This deformity occurs about once in every 1200 births. The various theories regarding the etiology are not conclusive although heredity plays an important role.

The anatomical structures involved are the nose, lip, premaxilla, alveolar borders and the vomer. In *unilateral cleft lip* the nostril is widened, depending upon the extent of the lip fissure. The ala is thinner than the normal side, and is stretched laterally, with downward displacement of the lower lateral cartilage. Instead of maintaining its characteristic form, the cartilage is spread into small islands, and fails to elevate and support the ala. The nostril on the noncleft side may be a mere slit resulting when the base of the columella is pulled to this side. The nasal tip is depressed, and pulled down on the cleft side. The unilateral cleft lip may be *complete* or *incomplete*, and when associated with a cleft through the alveolar border and palate, the separation may vary greatly in width. The lip is usually of unequal thickness on the two sides. The alar side of the cleft contains tissue of greater firmness and density. The labial frenum is wide, and has a low attachment on the alveolar border. The premaxilla is displaced forward, and rotated outward. The alveolar border on the alar side

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Fig 172—Unilateral complete cleft lip with a wide alveolar cleft. Note how the ala has been stretched to a thin band of tissue



Fig 173—Showing the anterior displacement of the premaxilla and philtrum, together with the outward flare of the nostrils.

is usually rotated inward and the shape of the philtrum is lost (Fig 172)

In *bilateral cleft lip* the nose is spread out and flattened. The nostrils are wide and the alae are stretched out. The nasal tip is drawn down especially when the vomer is overdeveloped. The premaxilla and the philtrum are thrust forward with obliteration of the columellar angle. Bilateral cleft lip may be *complete*, or *incomplete* on both sides or it may be complete on one side and incomplete on the other. The philtrum is continuous with the nasal tip and contains no muscular tissue or glandular structures. When displaced the premaxilla is usually rotated forward beyond the alveolar border and is suspended from the overdeveloped septum (Fig 173). When there is no palate defect the premaxilla is projected forward forming a V shaped cleft in the alveolar border.

PREOPERATIVE CARE OF CLEFT LIP

As the infant is unable to take the breast or even the bottle nipple when the defect is extensive, due care must be exercised to see that it is properly nourished before attempting any corrective operation. This responsibility is assumed by the pediatrician who decides when the infant is ready for operation as indicated by a steady gain in weight.

It is unwise to operate and then attempt to find a satisfactory feeding formula. X-ray examination to determine the condition of the thymus is a valuable prophylactic measure. Admission to the hospital should be at least twenty four hours prior to operation in order that blood and urine examinations may be made.

GENERAL CONSIDERATIONS IN THE REPAIR OF UNILATERAL CLEFT LIP

The objective is to restore the correct anatomical relation of the displaced and distorted structures. The nose should be restored to its normal appearance. The flattened nasal tip and ala should be raised to conform as closely as possible to the opposite side. The columella and septum should be straightened and the vermilion border must form a continuous line at its junction with the skin (Fig 174 A and B). The gingivolabial sulcus should be deep enough to allow free movement of the lip. The opening under the lip must also be closed at the time of the lip repair.

The Rose position is the most satisfactory for operation. The child's head is over the end of the table the surgeon is seated so that he may support the baby's head in his lap and the anesthetist sits at his

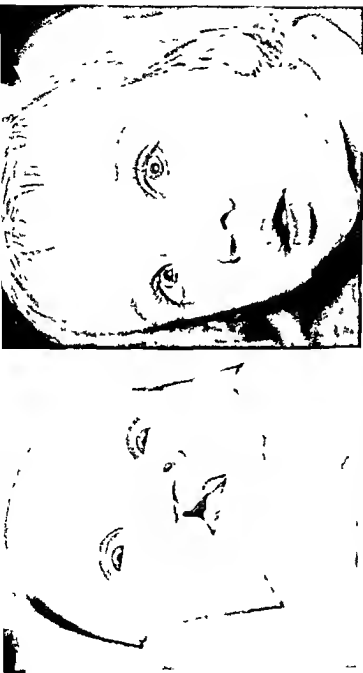
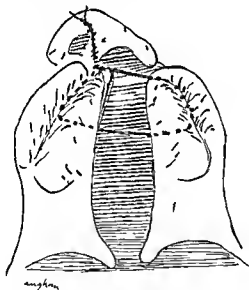


Fig 174—Some problems to be dealt with in unilateral cleft lip. A, An extreme nasal deformity with loss of contour on the affected side. B, After repair and adjustment of the lip and nasal alae.

left. The Rose position provides a free airway for the anesthetist, and the blood which collects in the nasopharynx is easily removed by suction. A suture passed through the tongue, draws the tongue forward and is then clamped to the sheet over the chest. Ether vapor is the most satisfactory anesthetic. After induction by the open drop method or by the closed mask the ether vapor is given through a bent metal tube in the angle of the mouth. It is necessary to keep the patient lightly anesthetized as the margin of safety is narrower than with older children and adults and the child can pass quickly into profound anesthesia.

REDUCTION OF THE ALVEOLAR CLEFT

When the alveolar cleft is not too wide, the pull of the repaired lip will approximate the borders. However, when the alveolar separa-



t lip
the

tion is unusually wide (Fig 175) the space can be reduced by digital manipulation and held by a silver wire through the two sections of the maxilla. The wire should be inserted high up in the canine fossa to avoid the tooth follicles. The ends of the wire are carried around under the mucous membrane of the gingivolabial fold and twisted

tightly enough to hold the approximation (Fig. 176). The wire should not be continually tightened in order to force approximation of the

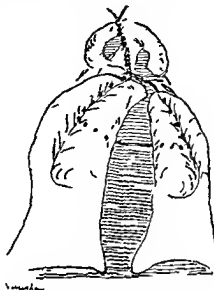


Fig. 176—A diagrammatic sketch to show the alveolar border after approximation by digital pressure. The silver wire is then twisted together anteriorly to hold the approximation.

alveolar borders as it will only cut into the tissues. Its purpose is to hold the approximation obtained by digital force.

THE REPAIR OF UNILATERAL CLEFT LIP

The vertical length of the lip from the alar facial attachment to the vermillion border on the normal side is measured with dividers (Fig. 177 A). Retaining the width of the dividers a point, A, is marked at the base of the columella and at the point where the other arm of the divider meets the vermillion border the skin is pricked to indicate the point B. This gives the length for the central portion of the lip. Beginning at A, the lip is transfixated with a No. 11 Bard Parker knife. The knife is carried down to the point marked by the dividers at B, separating the skin and vermillion border. An incision is made around the ala, following the alar facial angle to the inner point of the alar labial attachment, point A'. The incision is then curved downward to pass through the border where the vermillion commences to

thicken at point B'. The skin and mucosa of the incised margins are undermined. An incision is made along the alar rim within the nostril (Fig 177 A). A small, sharp elevator is inserted to separate and undermine the skin and mucous membrane of the ala, and the undermining is continued over the nasal tip. This raises the ala, and avoids angulation when the tip of the ala is turned into the columella. The

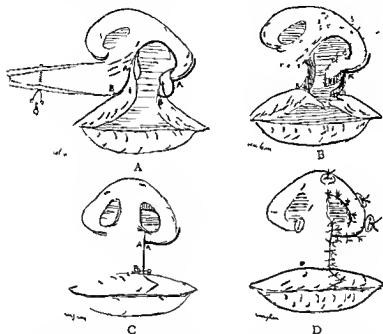


Fig 177—A diagrammatic sketch indicating the successive steps in the correction of a unilateral complete cleft lip. A The method used in planning the incisions on the sides of the cleft. B Dotted area indicates the region that has been undermined and the incisions in relation to the ala as well as the opened lip incisions. C The flaps adjusted for suture, also the upper angle of the nostril where a small crescent of tissue has been removed to equalize the height of the nostrils. D, The lip after suture. Note the mattress sutures tied down on buttons of thin silver or lead to support the ala.

tip is thoroughly undermined including the columella and the septum (Fig 177, B). The ala and the excess tissue from the upper margins of the cleft are turned in and sutured to the columella, utilizing an amount necessary to restore the nasal floor. The mucocutaneous borders are united with fine silk where the vermillion contacts the skin. The suturing is continued upward from the lip border to the

nose, as it is easier in this way to equalize the length of the lip on each side. It is usually necessary to excise a crescent of tissue from the upper and inner angle of the nostril on the cleft side to equalize the height of the nostrils (Fig. 177, C). The vermillion on the alar side is split, and the excess tissue from the columellar side is fitted in and sutured. The ala is supported by a mattress suture which passes through the septum, and is tied down on lead buttons. Mattress sutures on lead buttons are tied down on a lead button over the nasal tip to support the raised ala. Fine silk sutures are used for approximation, very fine for the skin, and a size larger for the mucous membrane surface (Fig. 177, D). A Logan bow is applied to support the lip suture line when the baby cries.

THE REPAIR OF BILATERAL CLEFT LIP

General Considerations.—The older operations for the repair of bilateral cleft lip were planned with the idea of adjusting the incised alar borders around a philtrum which had been denuded of vermillion. The result, in most cases, was a lip long vertically and short transversely. No matter how small, the philtrum should be used to form the central portion of the lip as it will then develop to provide a lip of ample length although a secondary correction at one or two years of age may be necessary to straighten out a notch in the border (Fig. 178, A and B).

Replacement of the Premaxilla.—The premaxilla is in normal position or only slightly displaced in a large percentage of bilateral cleft lips, and can be repaired in a one stage procedure. When the premaxilla is thrust forward by overdevelopment of the vomer retroplacement is necessary before the lip can be repaired (Figs. 179, A, B and C). The method most frequently suggested is to excise a V shaped section from the vomer just posterior to the premaxilla. The objection to this method is that the premaxilla rotates backward on its transverse axis or is completely separated from the vomer attachment and due to loss of blood supply, fails to develop or to support the lip. This condition becomes progressively worse as the child develops, and the final result is a flat lip without bony support. A premaxilla that has been moved backward to form what seems like a well shaped dental arch at the time of the primary repair is too far back to give proper support as maxillary and facial development progress.

The premaxilla should be retriplaced only enough to permit repair of the lip over it, and the blood supply should be conserved so that normal growth can proceed. The most satisfactory method is to make



Fig 178 --Demonstrating that the philtrum contains enough tissue to form the central portion of the lip A A bilateral cleft lip with moderate anterior displacement of the premaxilla and philtrum B The lip with a well developed philtrum after one stage of repair The vermilion border will be revised at the next stage

nose, as it is easier in this way to equalize the length of the lip on each side. It is usually necessary to excise a crescent of tissue from the upper and inner angle of the nostril on the cleft side to equalize the height of the nostrils (Fig 177, C). The vermilion on the alar side is split, and the excess tissue from the columellar side is fitted in and sutured. The ala is supported by a mattress suture which passes through the septum, and is tied down on lead buttons. Mattress sutures on lead buttons are tied down on a lead button over the nasal tip to support the raised ala. Fine silk sutures are used for approximation, very fine for the skin, and a size larger for the mucous membrane surface (Fig 177, D). A Logan bow is applied to support the lip suture line when the baby cries.

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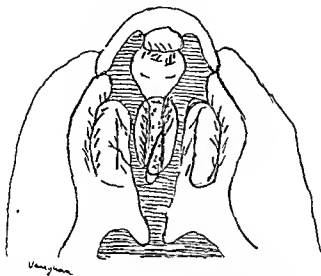


Fig 180—Diagram showing the oblique chisel cut posteriorly in the vomer to permit retroplacement of the premaxilla. When the vomer is cut in this region the premaxilla cannot break away from its vomer attachment.

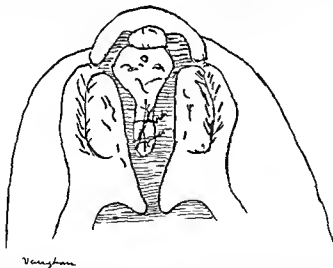


Fig 181—Diagram showing the premaxilla moved backward sufficiently to permit closure of the lip clefts. Care must be taken to obtain only the minimum of retroplacement to avoid a flat lip from lack of premaxillary support. The overlapping sections are held by silver wire sutures, and the

an incision along the posterior border of the vomer. The mucoperiosteum is elevated on each side and held by thin retractors. A thin,

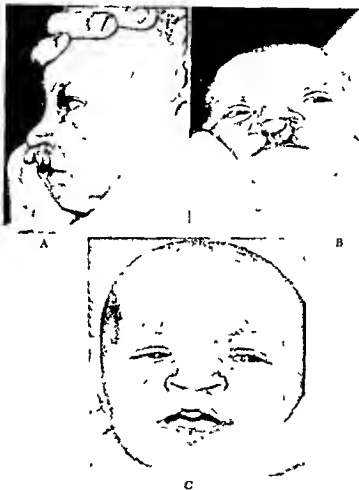


Fig. 179—Bilateral complete cleft lip with extensive anterior displacement of the philtrum and premaxilla. A, Lateral view of displaced philtrum and premaxilla. B, Anterior view which shows displacement and rotation of the premaxilla. C, After retroplacement of the premaxilla and first stage repair of the lip.

broad chisel is used to cut the vomer obliquely, the cut extending well up the cartilaginous septum (Fig. 180). The premaxilla is then pushed backward far enough on a horizontal plane to permit closure of the

An incision is made around the ala at the alar facial attachment on each side, continued through the upper end of the vertical incision and on through the mucosa at the margin of the cleft. This separates the ala so that it can be turned in for attachment to the base of the columella (Fig 182, A). The skin is undermined along the lip incisions. The ala is well undermined on each side, and separated from the alveolar attachment. The philtrum, however, is not undermined or separated from the premaxilla, as it is essential for its development to avoid any interference with its blood supply (Fig 182, B).

In closing the lip, the ala is turned in and sutured to the base of the columella to restore the floor of the nose. The philtrum is then united to the alar side of the lip. The first suture begins at the junction of skin and vermilion, then up the lip toward the nose (Fig 182, C). When the suturing of the skin and mucous membrane under the lip has been completed on both sides, the lower vermilion on the philtrum is split and reinforced by the excess vermilion from the alar sides. These flaps are fitted in and sutured. The lip sutures are fine silk for the skin, and one grade larger for the under surface. The alae are supported by a mattress suture which passes from side to side under the columella, and is tied down on buttons of thin lead or silver. The suture line is kept covered with a 5 per cent sulfathiazole ointment for protection. The lip should be immobilized and supported against excessive movement and strain on the suture lines. A mattress suture tied down on buttons of thin lead, one on each side of the suture line, gives excellent support (Fig 182, D). The Logan bow is also used but may not furnish sufficient support when there is unusual tension on the suture lines. It is then safer to use a mattress suture of No. 00 dermal passed through adhesive plaster that has been adjusted on each side of the face. The dermal suture is also tied down on lead buttons. The objection to this method is that there is some scarring where the sutures come through.

POSTOPERATIVE CARE OF CLEFT LIP

It is necessary to see that the airway is free before the baby leaves the operating room, as sometimes the repaired lip is sucked in with a valvelike action that interferes with respiration. A piece of rubber tubing in the nostril, or a larger tube held by adhesive in the angle of the mouth, will correct the condition until the baby reacts, although occasionally it must be left for several days. The baby is put to bed, lying on his abdomen so that blood and saliva will run out of the mouth. If there has been much bleeding, an infusion of 5 per cent

mucoperiosteal incision is closed with silk (Fig. 181). The lip operation is delayed for three or four days.

Technic of Repair.—Beginning at the base of the columella from the point A (Fig. 182, A), the vermillion along the border of the philtrum is incised down to the point B on each side, leaving the lower border intact. The length of the incisions is measured, and the dividers are closed to two-thirds of this distance. The point A' is then marked on each side at the lower border of the attached margin of the ala.

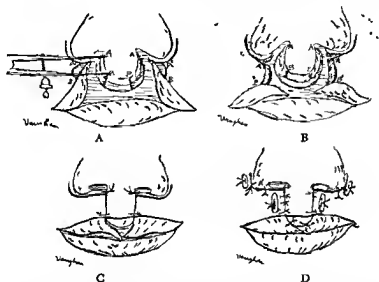


Fig. 182—A diagrammatic sketch to show the successive steps in the repair of bilateral cleft lip. A, Illustrates the use of dividers in equalizing the length of incisions for the flaps. B, Dotted portions indicate the undermined areas. The incisions have been completed and the lip sections opened. C, The flaps have been approximated on each side. D, The flaps have been adjusted and sutured. Note the mattress suture tied down on thin silver buttons to support the alae, and the mattress suture in the lip to support the suture lines.

With one arm of the dividers at A', the point B' is indicated where the other arm of the dividers contacts the junction of skin and vermillion border. The lip is transfixed with a No. 11 Bard Parker knife at A', and the skin and vermillion are separated on each side down to B'. This incision should be curved so that the length will be about equal to the incision A-B in the philtrum. Any skin within the length of the incision that remains in contact with the vermillion junction should be removed.

THE SURGICAL TREATMENT OF LARGE HEMANGIOMAS OF THE FACE IN CHILDREN

WILLIAM F. MACFEE, M.D., F.A.C.S.*

HEMANGIOMAS appearing on the face or other parts of a newborn baby are popularly known as birthmarks, and folklore has attributed them to various prenatal influences. The capillary hemangioma, known also as the *nevus flammeus*, or port wine mark, has been related in lay fancy to fright of the pregnant mother by fire while carrying the affected child, the location of the mark is determined by where, in the gesture of fright, the mother happens to place her hand, usually upon the face, scalp or neck. Similarly the *nevus vasculosus*, or strawberry mark, has been ascribed to an unfulfilled craving of the pregnant mother for strawberries.

Origin and Development.—Upon a scientific basis, Ribbert¹ made an exhaustive study of the origin and development of hemangiomatous tumors and concluded that they arise in a segment of blood vessel wall from which they grow by a process of endothelial budding. These buds expand into elongated strands which later become canalized to form new blood vessels. The new vascular processes do not ordinarily connect with neighboring normal vessels, but tend to grow around them or push them aside.

Hemangiomas are common in infants and in the majority of cases appear as congenital tumors. As a rule they are said to grow slowly until adult life is reached, after which growth is arrested. However, a history of a rather sudden onset of rapid growth is by no means uncommon in children, and though they rarely become truly malignant, they may encroach upon normal structures and greatly affect their configuration and function.

In a large series of cases reported by Watson and McCarthy² from the Memorial Hospital, 73 per cent were present at birth and 85 per cent had developed before the end of the first year. Fifty six per cent of all hemangiomas in the series were situated on the head and neck, 52 per cent being on the head. The ratio of females to males was 65 to 35, and the authors state that in some clinics the ratio is three females to one male. Fig¹ gives it as approximately two to one.

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glucose in sahne is given. A blood transfusion is sometimes indicated. Elbow splints are used to keep the hands away from the mouth.

CONCLUSIONS

1 In the correction of unilateral cleft lip the contour of the lip and nose on the cleft side should be restored to match and harmonize accurately with the normal side.

2 In bilateral cleft lip it is important to use the prolabium and philtrum to the fullest extent, and thus avoid the conspicuous defect so often seen in a lip, long vertically, and short transversely.

3 Conservation of the premaxilla is of equal importance for continued support of the lip. When replaced too far back, the lip is inverted, flat and unsightly.

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regression of the tumor, or to the selection of the wrong therapeutic agent through failure to appreciate the depth, extent and particular type of lesion. The treatment actually chosen doubtless depends a great deal upon who treats the lesion first and what therapeutic agents he feels most capable of using. It is probable that the greatest number of hemangiomas are first seen by the dermatologist and dermatological methods are employed.

SURGICAL TREATMENT

Illustrative Cases—It is not the purpose of this discussion to examine closely the relative merits of the various forms of treatment, but rather to discuss the application of surgical therapy to certain large



Fig 183 (Case I)—H. B. age $2\frac{1}{2}$ years. Appearance on admission to St. Luke's Hospital September 19, 1934. The tumor appeared first on the upper lip and extended to include the nose.

hemangiomas, when surgery has been selected as the appropriate treatment. By way of introduction it may be profitable to describe a few cases in point.

CASE I—This patient H. B., a white girl, two and one-half years old, was admitted to St. Luke's Hospital September 19, 1934. At birth there was a small red spot on the upper lip near the septum of the nose. This increased rapidly in

Jacobs⁴ set the number of hemangiomas appearing as definitely congenital lesions at 75 per cent with 55 to 60 per cent occurring about the head. It is well established statistically and by common observation that the great majority of hemangiomas are congenital, that most of them are above the shoulders, frequently on the face, and that most of them unfortunately affect girls.

Types—The types of hemangiomas have been classified by Mac Kee⁵ as *nevus flammeus* (port wine mark), *nevus vasculosus* (strawberry mark), and *angioma cavernosum* (cavernous angioma). To these should be added the *hemangioma racemosum* or *cirsoid hemangioma* described by Deetz⁶ which fortunately is not common.

Selection of Treatment—There is great variation in size of all the common types of hemangioma, some being only a few millimeters in diameter while others may attain very large proportions. When a large tumor of the kind mars the features of a newborn infant, its removal becomes a matter of utmost concern to the parents. It is also important that removal should leave the slightest deformity possible.

Opinion as to how this should be accomplished changes with time and with the means available for treatment. Wyeth⁷ in 1902 and Reder⁸ in 1915 recommended the treatment of pleomorphic and cavernous hemangiomas by injections of boiling water into the tumor. Da Costa⁹ in 1917 described a number of methods of treatment including solid carbon dioxide, electrolysis, and various forms of heat. He believed, however, that excision was the best treatment when it could be accomplished safely. In more recent times radiation and injections of various chemical solutions have become the methods of treatment most frequently employed. Pohle and McAneny¹⁰ favor radium and

Watson and McCarthy² have indicated that injection of sodium morrhuate in 5 per cent solution is the preferred treatment at Memorial Hospital. This is noteworthy in view of the fact that Memorial Hospital possesses an ample supply of radium and excellent equipment for roentgen therapy. Andrews¹² also favors injection treatment but uses a solution of quinine and ethyl carbamate (urethane).

Little has appeared in the recent literature concerning the value of surgery but MacCollum¹³ believes operative removal gives best results when it does not cause deformity or injury to adjacent parts. Bailey and Kiscadden¹⁴ have expressed the opinion that most of the bad results are due to a watchful waiting policy, hoping for a spontaneous



Fig 184 (Case 1) —Appearance June 5 1940 six years after removal of tumor and prior to reconstructive work. (Photograph secured through courtesy of Dr Jerome Webster)



Fig 185 (Case 1) Recent photograph showing result of reconstructive work by Dr Jerome P Webster

size to its present dimensions. On four different occasions she had had severe hemorrhages from the tumor from injury.

Examination Practically the entire nose is replaced by a large, reddish blue lobulated tumor mass which has the general shape of a pear (Fig 183). The septum and the adjacent portion of the upper lip are also involved in the tumor which is approximately 4 by 4 by 3 cm in greatest dimensions. On palpation the mass is spongy, compressible, blanches to some extent on pressure, but quickly regains its size and color when pressure is released. The nares are almost occluded by encroachment of the tumor growing from the nose and the upper lip. There is a slight sense of pulsation to the touch but the tumor does not definitely expand with the heart beat.

Diagnosis Capillary and cavernous hemangioma of the nose and upper lip.

First Operation On September 20, 1934 under rectal ether anesthesia a curved incision was made along the upper margin of the tumor and the skin was dissected from the tumor and reflected downward uncovering the mass on the nose. The tumor was then freed from the underlying nasal structures and removed. There was considerable loss of blood in spite of slow dissection and the ligation of numerous bleeding points. For this reason removal of the labial part of the tumor was deferred.

Convalescence was relatively smooth. There was some sloughing of the skin flap at the upper margin on the right side of the nose and healing here was by granulation and marginal epithelialization.

Second Operation On May 26, 1936 under ethyl chloride-ether anesthesia a transverse elliptical incision was made over the tumor of the upper lip at the base of the septum. The thin skin flaps were dissected away from the tumor which was then undermined and removed. The many bleeding points were clamped and ligated with relatively little loss of blood. A transfusion of 80 cc of whole blood was given following the operation.

Convalescence was without noteworthy complications and the patient was permitted to go home on the tenth postoperative day. There was gradual improvement in appearance but defects of soft parts and cartilage at the end of the nose detracted from her appearance (Fig 184). In June 1940 the patient was referred for reconstructive work to Dr. Jerome P. Webster to whom I am indebted for the photograph Figure 184 which was taken before repair work was begun. Figure 185 taken after repair work is from a recent photograph sent by the patient's parents.

CASE II—The patient C. B. a white male infant one year old was admitted to St. Luke's Hospital April 10, 1940. At birth a red tumor mass was noticed on the right cheek but for the first three months of life it remained rather inconspicuous. At the age of three months radium treatments were begun and the patient received a total of 14 treatments at weekly intervals. In spite of the treatments the tumor increased in size and upon one occasion cracked and bled.

Examination The malar region of the right cheek is occupied by a large bluish red soft, compressible spongy mass which produced marked asymmetry of the face (Fig 186). The right eye is partially closed by encroachment of the tumor and the angle of the mouth is depressed to such an extent that there is drooling. On the inner aspect of the cheek and on the soft palate there are numerous dilated capillaries.

First Operation June 2, 1941. This operation consisted of ligation and division of the right external carotid artery above the level of the superior thyroid branch.

Examination Over the left eye and completely occluding it there is a swollen, purplish mass with serpentine border which measures 5 by 4 by 4 cm in greatest diameters and completely occludes the eye. In the center the skin has broken down and the ulcer is covered by dry crust. The mass is soft, compressible, and almost fluctuant. It involves the upper eyelid, including the conjunctiva, which shows greatly increased vascularization and redundancy (Fig 189)

First Operation On February 27, 1946, under open ether anesthesia, the left external carotid artery was exposed and divided between ligatures immediately above the superior thyroid branch.



Fig. 187 (Case II) —Appearance June 3, 1942, showing result of removal of main part of tumor with preservation of overlying skin, also involved in tumor. In retrospect, it probably would have been better to remove entire tumor, including skin, at first operation.

The angioma of the forehead was then surrounded by an incision through the skin and dissected off the forehead. The skin of the upper eyelid was dissected off the palpebral portion of the tumor and reflected downward as a flap which was left attached to the lid margin. The underlying tumor was then removed as completely as possible without disturbing the orbicularis muscle, and the skin of the lid was resutured in its original site. The defect on the forehead was covered

palpebral fissure. To overcome the protrusion, with the probability of ulceration,

Second Operation June 9, 1941. One week after ligation of the external carotid artery an incision was made along the lower, medial and lateral borders of the tumor and the entire tumor was dissected from its bed and reflected upward with the skin flap. This approach was adopted to permit control of the main vascular channels before they entered the tumor. After the tumor had been lifted from its base it was dissected free from the overlying skin and removed. The skin was then sutured in place and a dressing of cotton wet with normal saline was applied.

Angiomatous tissue was still present in the skin flap but considerable reduction of the original tumor was accomplished (Fig. 187).

Third Operation June 4, 1942. At this time the residual tumor including the skin was excised by Dr. B. R. Shore and the defect was covered by a Thierversch



Fig. 186 (Case II)—G. B. aged 1 year. Appearance on admission to St. Luke's Hospital, April 10, 1940.

graft. There was partial loss of the graft and healing over this area was by granulation and marginal epithelialization. The late result of the various operative procedures are seen in Figure 188. Further corrective measures are to be carried out.

CASE III—The patient F. W., a white female infant, five and one-half months old, was admitted to St. Luke's Hospital February 18, 1946. At the time of birth

an ulcer which has persisted to the present time.

the upper and lower lid margins were denuded of epithelium at two points and sutured together

Third Operation June 12, 1946 Following the previous operations it became increasingly obvious that hemangiomatous tissue not only persisted in the upper lid, but that it actually was increasing and appeared to involve the entire thickness of the lid, including the conjunctiva

An attempt was made to excise as much of the involved tissue as possible without damage to the eye, and without destroying the function of the musculature of the upper lid The excision was done through a transverse elliptical incision which included a part of the involved conjunctiva At the end of the



operation the wound was repaired and the lid margins were again sutured together

On July 11 1946 the patient was allowed to go home to await the results of the operative procedures She returned to the hospital November 9, 1946, and the results to date are seen in Figure 190

Comment—The results in these cases are by no means perfect, and in order to secure the best appearance possible, work remains to be done in each instance The lesions, however, were large and their destruction by surgical means without excessive damage to normal structures has been largely accomplished Whether better results



Fig 188 (Case II) —Appearance June 29 1948 four years after completion of removal of tumor with involved skin Operation by Dr B. R. Shore



Fig 189 (Case III) —F W 5½ months old Appearance on admission to St Luke's Hospital, February 18 1946

quent undertakings. It is important that reparative procedures be well planned and that they be delayed until they can be carried out under auspicious circumstances.

SUMMARY

- 1 Surgery properly applied, is an effective and relatively satisfactory means of dealing with large hemangiomas of the face.
- 2 The danger of severe hemorrhage can be largely eliminated by ligating the external carotid artery. Temporary control may be secured by means of a traction thread passed around the vessel.
- 3 To limit the amount of scar tissue formation with resulting contractures and to reduce the risk of infection, prompt healing of the wound should be promoted by a free skin graft of intermediate thickness.
- 4 Definite repair of residual defects should be planned deliberately, correctly timed, and carried out under favorable circumstances.

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could have been achieved by physical or chemical agents is a matter of opinion. The dangers of heavy irradiation about the eyes and over the nasal cartilages are well recognized. Perhaps the chief advantage of surgery in such cases is the possibility of accurate control and limiting its effect to the desired extent.

Technical Considerations.—On the technical side of surgery, the control of hemorrhage is a matter of real concern. Consisting as they do of a mass of blood vessels, hemangiomas bleed furiously when directly attacked, and hemorrhage which would be negligible in an older person may be dangerously exsanguinating in a small child. In dealing with large hemangiomas in any region it is highly desirable to control the blood supply at a safe distance from the tumor. This can be done with relative ease in vascular tumors affecting the face, particularly if the lesion is confined for the most part to one side.

Ligation and division of the external carotid artery on the affected side substantially reduces the danger of uncontrollable bleeding. The division is made immediately distal to the superior thyroid branch and, in infants, care must be exercised not to include the internal carotid. If only temporary control is desired, this can be secured by passing a thread or tape about the external carotid and exerting traction. With the blood supply effectively controlled the tumor can be removed without great danger, even though it be of large size. No such operation should be undertaken, however, without an ample supply of blood at hand for prompt transfusion if needed.

The surgical objective should be complete removal of the entire tumor including affected skin at the first operation. This aim, of course, cannot always be achieved. After excision of the tumor, the wound as a rule cannot be closed, and the surface should be covered by a free skin graft of intermediate thickness, held in place by fine silk sutures. Further corrective measures can be carried out at a later time. No immediate attempt should be made to raise a flap for purposes of repair, particularly in the field supplied by the external carotid if that vessel has been ligated. If for any reason an immediate pedicle graft from the forehead or other adjacent part is planned, control of the external carotid should be secured by temporary traction so that the vessel may be preserved as a carrier of oxygenated blood.

Once the tumor has been removed, there need be no great hurry, as a rule, in carrying out the further surgical procedures necessary for improvement of appearance. Haste may lead to ill advised operations which not only fail in their purpose but also compromise subse-

quent undertakings. It is important that reparative procedures be well planned and that they be delayed until they can be carried out under auspicious circumstances.

SUMMARY

- 1 Surgery, properly applied, is an effective and relatively satisfactory means of dealing with large hemangiomas of the face.
- 2 The danger of severe hemorrhage can be largely eliminated by ligating the external carotid artery. Temporary control may be secured by means of a traction thread passed around the vessel.
- 3 To limit the amount of scar tissue formation with resulting contractures and to reduce the risk of infection, prompt healing of the wound should be promoted by a free skin graft of intermediate thickness.
- 4 Definite repair of residual defects should be planned deliberately, correctly timed, and carried out under favorable circumstances.

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GROSS INTESTINAL HEMORRHAGE IN INFANTS AND CHILDREN

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THE cases which I wish to present in this paper represent examples of some of the more common causes of gross intestinal hemorrhage in infants and children. There are many conditions which show various degrees of intestinal bleeding or which may show stools which are positive to the guaiac test, but I wish at this time to discuss only conditions in which the patient may be admitted to the hospital showing severe loss of blood from intestinal hemorrhage.

Intussusception is a common surgical emergency in children and almost always bloody stools or the characteristic currant jelly stools are found but rarely if ever is the amount of blood lost sufficient to affect the child seriously. In the order of their importance the conditions to be presented here are (1) Meckel's diverticulum containing heterotopic gastric mucous membrane with ulceration, (2) duplication of the small intestine, (3) polyp of the colon (not multiple polyposis), (4) duodenal ulcer.

MECKEL'S DIVERTICULUM

present illness ten hours before. Upon admission to the hospital the physical

tion could be ruled out for the following reasons: (1) no history of abdominal
vious extent of the

oglobin rose to 90 per cent in the next few days. On the sixteenth day proctoscopic examination was entirely negative. Barium enema also failed to reveal pathologic condition. In view of the rapid cessation of the bleeding and the apparently complete recovery in a few days, the baby was discharged home. The mother was warned that if he bled again he would have to be operated upon and she was advised to bring him back immediately if he had a tarry stool. The wisdom of this course

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of treatment may be questioned but one hesitates to perform an exploratory laparotomy on an eight month old baby without sufficient proof that there is no other course to pursue. One month later the baby was readmitted with a history of having had tarry stools a few hours before admission for the first time since discharge. He was given two transfusions in the next few hours and operated upon. At operation a Meckel's diverticulum was found two feet above the ileocecal junction and was removed. His recovery was uneventful. Pathological examination of the Meckel's diverticulum showed that it contained heterotopic gastric mucous membrane with ulceration.

Unfortunately, Meckel's diverticulum and duplication of the small intestine are not demonstrable by x ray examination and, as with most of the conditions I wish to discuss the diagnosis often must be made by the process of exclusion. Duodenal ulcers frequently are not demonstrable by x ray (particularly the posterior wall ulcer which is the type most apt to bleed) and single polyps of the colon can easily be missed by barium enema even though double contrast media are used.

DUPLICATION OF TERMINAL ILEUM

Duplications of the small intestines are frequently the cause of gross intestinal hemorrhage in infants and children because they frequently contain heterotopic gastric mucous membrane with ulceration. The most common site of duplications of the intestine is in the region of the terminal ileum at the same site where Meckel's diverticulum is found. They differ from the latter in that they lie in the mesentery and have the same blood supply as the gut they parallel, while Meckel's diverticulum is always found arising from the antimesenteric border of the gut. A duplication may be but a few inches long or may exist as a tube 12 to 30 inches long looking exactly like the loop of gut it parallels. It probably is the result of development of embryonic rests and in this form is often called an enterogenous cyst. Duplications often communicate with the loop of bowel they parallel but may be completely blind at both ends.

CASE II—The patient was a male baby nine weeks old born in a hospital outside of New York. He seemed to be perfectly well for the first seven weeks of life and then rather suddenly looked quite pale and the mother noted that he had passed a tarry stool. He then passed large quantities of tarry material by rectum and was given several transfusions. He seemed to pass the blood by rectum just about as fast as it could be given by transfusion. Two weeks before admission here at the age of nine weeks after numerous transfusions he was operated upon at the hospital where he was born. The surgeon found a duplication of the terminal ileum but, believing that the baby's condition was not good enough to permit a resection, he closed the abdomen.

The baby continued to pass large quantities of blood per rectum and in the next ten days required numerous transfusions. About ten days after the exploratory laparotomy his condition seemed good enough to transfer him to Babies Hospital. Upon admission he was given another transfusion and operated upon, just two weeks after the previous laparotomy. A duplication of the terminal ileum was

Consequently, it was resected with the loop of ileum and a side to side anastomosis of the terminal ileum was performed, using two rows of fine chromic gut and one row of interrupted C silk.

The baby's convalescence was uneventful. The incision healed by primary union and he was discharged home twelve days after the operation. Pathological examination of the duplication showed that it contained gastric mucous membrane with ulceration. He has had no further bleeding and is developing normally.

POLYP OF THE DESCENDING COLON

CASE III—This case is that of a six and one half year old girl who had had small amounts of bright red blood in the stools on several occasions during the three years previous to her admission to St. Luke's Hospital. She had not had a severe hemorrhage until the present admission. Physical examination was essentially negative except for marked pallor. Rectal examination revealed nothing of a pathologic nature. The erythrocyte count was 2,100,000, hemoglobin 44 per cent, and the guaiac test of the stool 4 plus positive. The girl was given an immediate transfusion of 400 cc. of whole blood and showed great improvement. After the bleeding had stopped proctoscopic examination revealed no pathologic lesion. Barium enema (double contrast media) also was negative. The patient was discharged home and the mother was advised that if the child had any further bleeding she would have to be examined and she was told to bring the patient to the hospital at the first sign of tarry stools.

One month later the patient was readmitted with a history of tarry stools.

Barium enema again was negative. Proctoscopic examination also failed to reveal any lesion.

With a provisional diagnosis of Meckel's diverticulum or duplication of the intestine, exploratory laparotomy was performed. A careful examination of the small bowel from the pylorus to the ileocecal junction gave negative results. The large bowel was also carefully palpated over its entire length and it was found to be normal. The abdomen was then closed, no cause for the bleeding having been found.

Convalescence was uneventful and the girl remained well for the next five months when she was readmitted with a history of having had tarry stools for three days. Proctoscopic examination was again negative but at this time the barium enema showed a polyp of the descending colon. Laparotomy was repeated and by careful palpation and transillumination of the unopened bowel the polyp was located but not until some time had been spent in trying to find it. The colon was opened at a point just above the left iliac crest and the entire polyp excised.

with its base. It had a very long pedicle and this was probably the reason that it was so elusive. The colon was closed with two rows of chrome sutures and one row of interrupted "C" silk mattress sutures. Convalescence was uneventful and the patient was discharged home ten days after the operation with her incision well healed by primary union. She has had no further bleeding.

The lessons to be learned from this case are. (1) A single polyp may be difficult to locate by x ray examination, even though double contrast media are used. (2) Even with the abdomen open a polyp may be difficult to find, particularly if it has a long pedicle. I have found transillumination of the unopened colon with a Cameron light quite helpful in locating polyps. It is understood of course that if the patient is properly prepared for operation the colon will be empty of all fecal masses.

BLEEDING DUODENAL ULCER

CASE IV—1 F, a 12 year old boy, was admitted to Babies Hospital because of weakness, pallor and tarry stools. Two years previously he had awakened early one morning feeling faint and had vomited a large quantity of bright red blood. He later passed tarry stools. This bleeding episode subsided in a few days' time but during the next two years the boy frequently complained of upper abdominal pain. Ten days before his first admission to Babies' Hospital he again had tarry stools, was quite pale and felt weak. The diagnosis upon admission was bleeding duodenal ulcer. The red blood count was 3,416,000, hemoglobin 87 per cent. After conservative treatment the bleeding ceased and a gastrointestinal x ray series showed a duodenal ulcer. He was treated on a Sippy regimen for five weeks and discharged greatly improved.

Five years later the patient was admitted to Presbyterian Hospital (he was over the age limit for Babies Hospital then) with a history of seven or eight episodes of bleeding since his discharge from Babies' Hospital. These episodes were always marked by pallor, a feeling of weakness and the passage of tarry stools. His blood count averaged 3,400,000, hemoglobin 85 per cent. He was again treated conservatively and discharged home after the bleeding stopped.

Two months later he was readmitted with the same complaint—pallor, weakness and tarry stools. The boy was operated upon at this time, the duodenal ulcer excised and a pyloroplasty performed. His convalescence was uneventful. About one year after operation he was again admitted to Presbyterian Hospital with a recurrence of the bleeding. Conservative treatment seemed quite successful and he was discharged home.

Twice in the following year he was readmitted and each time was treated conservatively. He was last seen in Follow-Up Clinic free from all symptoms during the preceding five year period.

While duodenal ulcers occur much less frequently in children than in adults, they occur often enough so that one must always bear in mind the possibility when considering the cause of gross intestinal hemorrhage in children.

HERNIA IN CHILDHOOD

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DIAGNOSIS

This child is two years old, a healthy, active boy who has had no serious illness but whose mother noticed shortly after his birth a swelling in each groin, with enlargement of the scrotum. This swelling varied in size from time to time, increasing during a crying or straining spell but subsiding almost completely during sleep. There was usually some residual swelling in the left scrotal sac and some thickening.

This history is typical of a bilateral congenital inguinal hernia and can be relied upon implicitly. Frequently examination for inguinal hernia in an infant is deceptive and unreliable but the history as given by the mother of a swelling that comes and goes is practically always diagnostic. Rarely enlarged lymph nodes, cystic hygroma tumors or fat pads may cause doubt.

The diagnosis of bilateral, indirect or oblique inguinal hernia seemed clear cut. No other type of hernia would appear in the scrotum. The slight residual mass or thickening in the left scrotum was considered to be a communicating hydrocele, which emptied partly and at times completely into the peritoneal cavity. The contents of the sacs, when filled, was assumed to be small intestine, as large intestine rarely appears in scrotal hernias in children and omentum, the most common content of hernias in adults, is seldom sufficiently developed in young children to reach the scrotum.

SELECTION OF TREATMENT

Treatment of inguinal hernia in infants may be expectant, i.e., the child may be kept under careful observation to forestall incarceration and strangulation, or a truss may be used. This, if well fitted and kept clean and adjusted will with good fortune prevent the descent of the hernia and even lead to eventual obliteration of the sac. However, the annoyance of wearing a truss, the expense involved, the time consumed and the uncertainty as to cure lead frequently to the decision to undertake radical operative measures.

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consist of obvious pain, vomiting, a tense mass and obstipation are symptoms demanding immediate operation

This particular child seemed at times to feel uncomfortable from the hernias and to have more than the usual number of digestive upsets. The mother was unable to give the time or afford the expense of fitting a truss and keeping it adjusted. She requested relief by operation and although the ideal age for operation is 4 years or over it was decided to proceed at once, especially as the mother was expecting another baby. Of course it is not uncommon to have to operate on young infants, even from birth, but the difficulty of keeping the wound clean militates against very early operation.

It is important in all hernias in males, and especially in children, to determine the size and position of the testes. If they are unusually small or undeveloped a note should be entered in the chart to that effect for future reference. If they are incompletely or improperly descended, this should also be noted and the operative procedure will have to be modified accordingly.

After due consideration and examination of the child, operation was at last advised and accepted.

OPERATION

Preparatory Measures.—The question of the *anesthetic* to be used was decided in favor of ether drop method, without preliminary medication. Avertin is useful for basal anesthesia to be completed by ether but skilled anesthetists are vitally important when combined drugs are used.

The child should be fastened to the operating table, or to a padded board on the table, with bandages to all four extremities to make sure no unexpected movement can occur. If the child is frail or the operation is expected to be prolonged or difficult, or accompanied by any loss of blood, hot water bottles should be used, with judgment, to keep the body warm. Preparation for infusion of glucose in saline, or even citrated blood, should be made even though the probability of their use is quite remote.

Preparation of the skin should be as simple as possible. Preference is given to simple cleansing with soap and water, rinsing, and one application of 70 per cent alcohol to be followed by tincture of merthiolate. This rarely irritates the skin and seems to protect it against the dermatitis from adhesive.

Draping should be as simple as possible as the field is small enough at best. One cover with sufficient opening to present both groins is plenty. This should be clamped or sutured to the skin.

Surgical Technique.—The skin incision is then made according to the custom of the operator. It should be long enough to afford a good exposure of the superficial and deep rings. The peculiar soft, white fat of the young child should be incised with one or two firm strokes down to the aponeurosis of the external oblique muscle. With gentle retraction and careful sponging the small vessels running in the subcutaneous tissues are seized with small clamps, taking care not to include any fat, and tied at once with fine silk.

At this stage it is well to suture or clamp with towel clips one layer of moist abdominal pads to each skin margin, allowing a bit of the pads to extend into the wound to cover the exposed fat. Then with gentle, blunt retraction the superficial ring is exposed and developed by blunt or sharp dissection. The aponeurosis of the external oblique is incised in the direction of its fibers to and through the superficial ring, and upward and outward to well above the deep ring. Considerable care must be exercised at this stage not to cut the ileo-inguinal or ileo hypogastric nerves, nor to injure the structures of the cord as it emerges from the superficial ring.

In very young children it is not necessary to clear the aponeurosis from the underlying internal oblique and transversalis muscles nor to clear the inguinal ligament completely to the spine of the os pubis but it seems better practice to do so. In this way a preventive type of operation will be performed which will practically warrant the prevention of a direct hernia later in life. It takes but an extra minute or so and certainly seems to be time well spent.

Frequently in small children the hernial sac can at this stage be seen covered by an extremely thin layer of cremaster fascia and a few muscular fibers. It is well, however, to split this fascia gently in the axis of the cord, remembering that there are moderately large venous channels directly beneath the sac. Now the entire cord with the sac may be easily freed from its bed and delivered, or preferably the sac alone is exposed throughout the length of the canal and gently freed from the structures of the cord. The sac in an indirect or oblique hernia is always anterior and slightly superior and internal to the cord.

Usually the sac is empty and thin walled. Its dissection at first about midway of the canal is easy as it is not adherent, and can be bluntly or by sharp dissection lifted off the vas and vessels. How-

ever, these structures are readily injured and they should be constantly kept in plain view. The sac may be opened at this stage in case of doubt but preferably it should be dissected out intact high up in the deep ring and completely separated from the vas and the vessels. The distal end of the sac is of less importance. If it ends blindly above the testis it is well to remove it entire. If it communicates with the tunica vaginalis testis the lower portion may be cut across and dropped into the scrotum, always remembering that the vas is immediately contiguous and may readily be injured. If this portion of the sac seems thick and likely to produce a hydrocele, it is well to split it and suture it loosely back of the testis.

The *treatment of the neck of the sac* is the crux of the operation for hernia in young children, just as in adults. The sac should be opened, any contents reduced, the neck transfixed with a fine curved needle and medium silk, tied, the excess cut away, a second tie placed on the neck and then it may be allowed to retract. Undoubtedly this alone is sufficient to cure all simple, indirect hernias in young children. However, as stated above it seems wiser to take precaution for the future. It is a simple matter to transplant the cord, place a few fine silk sutures to attach the conjoined tendon to the inguinal ligament, close the aponeurosis of the external oblique in a similar fashion, leaving a moderate new superficial ring—close the subcutaneous fat and Scarpa's fascia loosely and then the skin. The preferred suture for the skin in young children may be very fine subcuticular catgut to obviate the removal of stitches, sometimes a difficult and trying procedure in a temperamental child.

At the close of the operation the wound should be gently sponged with alcohol, followed by one application of tincture of merthiolate. The wound is covered with gauze and the opposite groin exposed for a similar attack on the other hernia. If by any chance the child is not doing well or has taken the anesthetic poorly, it is far better to postpone the second operation for a week or so.

Postoperative Care.—Dressing a hernia wound in an infant requires a bit of thought. Most surgeons prefer to seal the wound and use for this purpose one or two layers of gauze followed by a free application of collodion, Duo, or other occlusive dressing. This in turn may be covered by waterproof adhesive. It is no longer considered necessary to apply a spica bandage nor to restrain the child in any moderate activity in his crib. Fluids are given freely as soon as tolerated and the regular diet within twenty four or forty eight hours. If there is no undue febrile reaction and the parents can be trusted

the child may be allowed home on the third day. The only instructions are to keep him as clean as possible and not to allow him out of bed for a week. No rough play should be undertaken for two weeks. The wound should be redressed in one week and kept covered for ten days. Full activity is allowed after three weeks.

The advantages of early operation are quite obvious—the threat to the child's health and life is removed, the anxiety of the parents is relieved and an almost 100 per cent cure is offered. Moreover, the expense in time and hospital costs is less than at a later time. Later in childhood or adolescence time becomes more important. Operations of course, are never convenient.

The dangers of early operation, in skilled hands, are slight. The anesthetic is usually well borne and the operation itself offers little danger—much less than in adult years. The tissues are undamaged by truss wearing or by disease, healing is prompt. Operation does, however, require considerable special skill and patience in the handling of the delicate structures. Damage to the vas nerves vessels or testis and even to the inferior epigastric artery, may readily occur. The urinary bladder is rarely seen in these early hernias. The intestine is often seen but should never be injured.

About 25 per cent of all male children have an open processus vaginalis at birth. Many of the open processes may close in time but the weakness persists and may later develop into a true hernia with potentially disastrous results.

Recurrence of inguinal hernia operated upon in childhood is almost unknown if reasonable skill and care have been exercised. Only two instances have come to my attention, one in an adult whose sac had obviously not been completely removed in childhood, the second in an infant with strangulation, in whom the sac was tied off but not removed. recurrence was prompt.

At years concerning the

The most authoritative

Hospital for Ruptured and Crippled. Two books have been published which are authoritative—one by Alfred H. Jason, Blakiston Company, 1941 the other by Leigh F. Watson, C. V. Mosby Company, 1938.

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PREVENTION OF FETAL WASTAGE

L. V. DILL, M D,* AND J. W. PEARSON, JR., M D †

BALLANTYNE¹ was keenly disappointed that antenatal care had apparently not improved the lot of the unborn fetus. At that time, when clinics were young and but few statistical studies had been made, it was impossible to evaluate the importance of his contribution in respect to the conservation of either the mother or the fetus, even today the extensive prenatal work that is carried out is directed primarily toward improving the health and safety of the mother with but little conscious thought for the fate of the expected baby. The neonatal death rate has dropped precipitously during the last twenty five years and although there has been some decrease in the stillbirth and abortion rate, it has not been striking.²

The solution of the problem of fetal wastage depends in general upon three widely divergent factors: the reduction of the abortion rate, the anticipation and prevention of serious antenatal complications which affect the fetus, and the proper management of the mother during labor and delivery. Therefore, to be assured that optimum conditions exist at the time of conception, each pregnancy should be planned, and should be preceded by a medical consultation where preventive and corrective measures may be instituted when necessary.

ANTENATAL FACTORS

Ideally the parents should be young, both fetal and maternal mortality climb noticeably above the age of 30, and at the age of 40 both are 100 per cent above the average.³

The effect of *fever* and *acute febrile illnesses* on the male germ cell is well known⁴ and their effects on the ovary and the chromatin material of the ovum are suspected. Measles⁵ when contracted in early pregnancy has recently been incriminated in the production of fetal anomalies. It seems not improbable that other virus diseases may produce like disturbances when they exist in either parent prior to conception or in the maternal organism following it. In view of this, conception should not be attempted until sufficient time has elapsed to

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allow for complete recovery from the possible noxious effects of the infection

Syphilis tuberculosis malaria brucellosis and other serious chronic infections should be cured arrested or at least under good control before a pregnancy is advised for the increased incidence of fetal loss in uncontrolled or active states of these conditions is undoubted. The onetime "scourge" of infants—congenital syphilis—has been almost completely eradicated in our day by pre pregnancy and prenatal therapy for the mother.*

Chronic metabolic conditions such as malnutrition severe avitaminoses hyper and hypothyroidism may make conception difficult and the abortion rate in such states exceeds the normal by several times. They should be diagnosed and adequately treated prior to pregnancy.

Heart disease renal disease and neurologic abnormalities should be brought under surveillance prior to pregnancy studied carefully from the clinical and laboratory aspects and a prognosis rendered. Where these conditions are so severe as to be incompatible with maternal safety during pregnancy maternal death or therapeutic abortion may be avoided by advising against pregnancy.

The hereditary diseases such as diabetes hemophilia insanity and certain types of epilepsy as well as the chronic disabling conditions—arthritis deformans total blindness and the like—present some problem from the medical point of view but their greatest significance lies in the sociologic aspect. It is not expected that the doctor should dictate the policy in such matters—rather he should be able to give the uninformed individual an accurate prognosis regarding both the mother and the fetus.

It is of prime importance to discover and when possible to eradicate pathologic states in the pelvis. Vaginal septae bicornuate uteri and other lesions of this nature create a significant increase in fetal and maternal mortality if allowed to go unrecognized until the onset of labor. Chronic cervical infections should be eliminated and cervical lacerations evaluated. Myomatous uteri and retroversions should be noted and their role in producing abortion kept in mind. Adnexal disease should be recognized as a factor in sterility and ectopic pregnancy. Ovarian cysts myomas in the lower uterine segment and other lesions which may obstruct the pelvis should be evaluated as complicating factors of pregnancy.

ABORTION

With the conception we are immediately faced with the greatest source of fetal wastage—*spontaneous abortion* (Table 1). It is esti-

mated that approximately 50 per cent of all abortions are abnormal products of conception.⁷ Little is known concerning the cause of malformations but by providing young parents with the best possible state of health and nutrition prior to conception and during early pregnancy it is possible that abnormal chromatin combinations and poor early environmental influences on the fetus may be reduced.

The remaining spontaneous abortions offer a more hopeful picture. Uterine hypermotility, deficient vascularization of the placental site and poor implantation of the fetus may all lend themselves somewhat to hormone substitution therapy. Many optimistic reports of the extensive use of progesterone, the estrogens and vitamin E credit them with the prevention of abortion.⁸ Endometritis,⁹ a condition which would be very difficult to predict as a causative factor has been found in a fair percentage of early abortions. By curing acute and chronic systemic and local infections and by avoiding excessive sexual con-

TABLE 1

FETAL WASTAGE CLASSIFIED ACCORDING TO GENERAL CAUSATIVE AGENT

Cause	Incidence (per cent)
Abortion	
Spontaneous	15-25
Induced	5-15
Prematurity	1-2
Accidents of labor	1-2
Neonatal deaths	1-2

tacts during early pregnancy, it is possible that this source may be reduced.

Abortion due to strain or minimal trauma is not common, lay opinion to the contrary. The importance of bed rest at the onset of cramping pains or at the time of the expected menses cannot be underestimated, however, and the restriction of strenuous exercise, lifting, intercourse and douches is advisable at all times.

Induced abortion, the actual incidence of which can only be approximated, is a very fertile field for preventive measures. A large portion of this unfortunate type of wastage of human life may be prevented by the judicious use of contraceptive advice in a manner which does not offend the personal or religious sensibilities. The guidance of individuals inopportunately pregnant into channels where they may safely and without prejudice deliver their babies is likewise of prime importance.

The prevention of antenatal accidents to the baby lies greatly in the province of the obstetrician. While we decry any exposure of the

mother to undue risk for the sake of the baby, we also feel that indicated interference at an opportune time frequently benefits both mother and infant

PREMATURITY

The greatest cause of stillbirths and neonatal deaths is prematurity (Table 2), and the most frequent etiologic factor is the *premature spontaneous onset of labor* with or without rupture of the membranes¹⁰ Little is known concerning the cause of the onset of labor and at present our only methods of combating this condition are by attempting to prevent contractions with sedation and hormone therapy at bed rest, failing this, the alternative is to deliver the baby with the least traumatic labor and delivery possible In the delivery of the premature infant sedative drugs which depress respirations should not be used during labor, the baby should be delivered under caudal

TABLE 2
ETIOLOGIC AGENTS OF STILLBORN AND NEONATAL DEATHS

Cause	Incidence (per cent)
Prematurity	40-50
Maternal and delivery complications	25-35
Malformation	8-12
Erythroblastosis	1-3
Syphilis	0.5-1

or local anesthesia with a wide episiotomy and low forceps used not as a tractor but as a buffer against cranial trauma¹¹

A large number of babies are lost each year because of the various *maternal toxemias of pregnancy* There is no field in obstetrics in which a greater nicety of judgment is needed The dilemma lies between too early termination with the delivery of a poor risk premature infant, and prolonged expectancy which results in an increased incidence of intrauterine death of the fetus as well as in undue risk to the mother

Another frequent cause of prematurity is overdistention of the uterus by *hydramnion* and *multiple pregnancies* Preventive measures are unknown and therapy is of no value at this time

Premature separation of the normally implanted placenta carries a very high fetal mortality both in premature and in term babies This tragic accident, sometimes occurring so massively and unexpectedly as to constitute an acute emergency will continue to exert its toll as long as the cause is unknown and preventive measures are not better understood Early diagnosis of massive separation of the placenta and

delivery of the baby by cesarean section before it is compromised by asphyxia occasionally results in salvage of a fetal life which would otherwise be lost

Placenta previa, still a serious complication for both mother and fetus, is much less malignant than in former years when unlimited quantities of blood were not available. Many babies can be saved from maturity losses by replacement of the blood loss as needed. Bed rest in the hospital and omission of vaginal or rectal examinations or attempts at delivery until the fetus has reached definite viability will often be successful. This type of therapy can, of course, be carried out only where hospitalization is feasible, and where trained help, constant observation and blood are not stinted, and where the presence of massive hemorrhage does not demand immediate interference.

Myoma uteri, severe heart disease, diabetes, pyelitis, surgical conditions and *trauma* all contribute to the incidence of prematurity, and with pre-conception consultation not a small share of these conditions can be corrected or controlled. A word should be said concerning pyelitis: chills and fever are rarely the first symptoms of this condition, and timely attention to the history of dysuria, flank pain and nocturia may serve to prevent the more serious stages of the disease from being reached. The questionably acute abdomen and semi elective surgical procedures should be carefully considered from all angles and by several consultants before laparotomy is attempted on the pregnant woman. If surgery is imperative, it should be performed with the least trauma to the pregnant uterus and as little should be done as is commensurate with the recovery of the patient. Spinal or local anesthesia are preferable, lacking these, anesthesia by inhalation with as high oxygen content as possible should be employed. Sedation and progesterone should be freely utilized post operatively.

The Rh factor has become recognized as a significant cause of fetal death in recent years, and fortunately at this time the means are at hand to prevent a large portion of these calamities. All Rh negative mothers whose husbands are Rh positive should have their blood examined at biweekly intervals once the baby has passed viability, and should such a titer be found that is considered to be dangerous to further intrauterine growth of the fetus, cesarean section (or induction from below where feasible) should be carried out. Women who have high antibody titers prior to pregnancy have little chance of delivering a live baby unless there is a heterozygous Rh genotype of the father, and in our opinion should be advised to refrain from becoming pregnant.

NATAL FACTORS

As term approaches the cause of death rests more and more on the shoulders of the obstetrician, and his responsibility lies in the prevention of asphyxia, birth trauma and infection.

Fetal asphyxia arises from a reduction in the oxygen supply and may derive from maternal causes such as oxygen poor inhalation anesthesia, cardiac failure, pulmonary conditions, anemia or shock, or from fetal abnormalities such as placental separation, prolapsed cord, a ruptured vessel from a vasa previa, knots or entanglements of the "lifeline," or cerebral anemia due to a severe driving labor or a general anemia due to erythroblastosis. It is taken for granted that the maternal causes have been reduced to a low level by adequate antenatal care. Placental separation has been discussed. When rupture of the membranes is accompanied by a pronounced fall in fetal heart rate, a careful vaginal examination may serve to demonstrate a prolapse of the cord. Delivery, if conditions are such that immediate action is possible, will prevent an otherwise certain death. If delivery is not possible, reposition of the cord should be attempted, and a bag or scalp traction utilized along with the constant administration of oxygen. Cesarean section may be justified in some instances. The administration of oxygen to the mother cannot be disregarded in any case of fetal distress, particularly where the cause of the distress is not evident at the time. The use of open drop ether in reducing the force of too severe labor is often of great help.

In any discussion of asphyxia in the newborn a mention must be made of analgesia and anesthesia. The use of such heavy sedation as completely to "knock out" the patient is unnecessary and results in asphyxiated and mentally deficient babies.¹² There is no doubt that local infiltration anesthesia and caudal anesthesia offer the least possibility for fetal anoxia, and ethylene oxygen should be used where any prolonged anesthesia is needed. The wise obstetrician will attempt to judge the anesthesia to be used in view of the probable difficulty of delivery, and will leave himself the widest margin of safety for the mother as well as for the newborn child.

Birth injuries, although they occur in the best hands, are admittedly due to faulty judgment or faulty technique. To gauge with safety the uterine power, fetal passenger, maternal passageway relationships requires the finest nuances of obstetrical judgment, but with the present day technique of x-ray pelvimetry fewer mistakes are being made. The extraperitoneal section has increased the margin of safety for an adequate trial labor, yet there is undoubtedly an inherent

danger in the overuse of a procedure which may be considered as a remedy for poor judgment. A long, hard trial of labor followed by the trauma of an abdominal delivery is not without risk to mother and fetus.

Table 3 shows the mortality rate for the fetus which is associated with the various generally used obstetrical procedures. It can readily be seen that as soon as one embarks on any operative procedure other than an outlet forceps the fetus automatically has less chance of survival. Statistics fail to take into account the fact that if the patient could have been delivered by an easy method, a hard one would not have been used. However, one should also consider the fact that much unnecessary interference is done, and that the few hours necessary to bring a high fetal head well into the pelvis may mean the reduction of fetal mortality from 40 to 4 per cent. We believe that in conditions in which immediate delivery seems imperative, any procedure used

TABLE 3

STILLBORN AND NEONATAL DEATHS ACCORDING TO TYPE OF DELIVERY

Type of Delivery	Stillborn (per cent)	Neonatal (per cent)
Spontaneous	0.5-1	0.5-1
Low forceps	1-2	1-2
Midforceps	1.5-3	1.5-3
Breech	8-10	7-10
Cesarean section	3-5	6-10
Version and extraction	20-30	14-20
High forceps	20-30	20-30

to facilitate delivery should improve the maternal and fetal mortality rate, otherwise the patient should be allowed to have more labor.

Breech delivery is often the cause of fetal injury—not only cerebral hemorrhage and asphyxia but injuries to the abdominal viscera, spine and nerve plexuses. Gentleness, a clear understanding of the breech mechanism and a "hands off" policy until the umbilicus is born will salvage many breech delivered babies. Premature breech infants are in even greater need of gentleness and care.

Version and extraction is being used with decreasing frequency as obstetricians are beginning to realize the danger to the baby as well as to the mother. It is at times indicated, but its use as an elective procedure is outmoded.

Shoulder dystocia is relatively infrequent, but a formidable opponent when met. The mechanism of shoulder delivery, the "tight ring maneuver," delivery of the posterior arm and the intentional fracture of the clavicle all should be well known and utilized.

The utilization of the induction of labor for the convenience of the patient or the obstetrician and the indiscriminate use of pituitrin to hasten labor, are to be decried. The maternal mortality from these procedures is not inconsequential and the fetal rate is atrocious.¹²

FETAL RESUSCITATION

All obstetricians should be trained in *fetal resuscitation*. Great strides in this field have been made in recent years and in most clinics the methods are standard. The fundamental principles are prompt clearance of the air passages, the administration of oxygen and the preservation of body heat. These simple principles will succeed in the baby which has not been asphyxiated beyond repair. Gentleness should be insisted upon and backslapping, swinging, contrast baths and other sterc measures are fast being discontinued. There is very little evidence to show that the respiratory and circulatory stimulants are of real value and they frequently do irreparable damage.¹⁴

It has always been and fortunately still is considered much more of a loss to have a maternal death than a fetal one. Obstetrics has made great strides in the past three decades, however, and with the extensive use of the antibiotics, plasma and blood, and highly technical procedures we can now afford to give more thought to the baby and still not unduly prejudice the life of the mother.

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ADDITIONAL ARTICLES

THE MANAGEMENT OF PREGNANCY AND TUBERCULOSIS

GEORGE SCHAEFER, M D *

THE treatment of the pregnant woman with tuberculosis must be individualized in that one must differentiate the type and extent of the tuberculous lesion and also the parity and obstetrical complications. Among the latter must be considered the presence of any cephalopelvic disproportion which may cause a prolonged labor, the presence of any of the toxemias of pregnancy, especially vomiting in the first trimester and, of course, the history of previous labors. Since the obstetrical procedures are dependent on the tuberculous lesions, the obstetrician must know something of the classification of tuberculosis.

Tuberculosis may be classified as exudative productive, chronic productive and caseous pneumonic.¹ In the exudative productive type the reaction is not severe, the exudate is absorbed in a few months and the patient becomes well. Chronic productive tuberculosis results when the tissue sensitivity is low and the dosage of tubercle bacilli small. The reaction is productive and very slowly progressive. A severe tissue reaction with caseation, necrosis, liquefaction and cavity formation results from caseous pneumonic tuberculosis. In addition to the above qualitative classification, tuberculosis is also classified quantitatively into minimal, moderately advanced and far advanced. One should not attempt to prognosticate the outcome of any case of pregnancy and tuberculosis without having ascertained all these facts.

Claims that therapeutic abortion is indicated in all cases of pregnancy complicated by tuberculosis or that the pregnancy is beneficial to the tuberculosis cannot be substantiated. When we compare the end results in pregnant and nonpregnant women with similar stages of tuberculosis, we find very little difference. In a series at Sea View Hospital² we found that between 1920 and 1930, when bed rest was

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the only treatment, the mortality in the pregnant group was 34 per cent compared to 33 per cent in the nonpregnant group. From 1932 to 1939 when collapse therapy was instituted, the mortality dropped to 17 per cent in the pregnant group and 26 per cent in the nonpregnant group. Since 1939 the addition of proper obstetrical care has further diminished the mortality in the pregnant group. The only mortalities during pregnancy were in the caseous pneumonic group with the exception of one case of chronic productive tuberculosis in the 1920 period in which the patient died of postpartum hemorrhage.

TREATMENT DURING GESTATION

The best results will be obtained when the tuberculous lesion and the pregnancy are treated concomitantly and adequately. In the exudative productive and chronic productive types, sufficient bed rest, proper diet including added proteins, iron and vitamin plus prenatal care will bring the patient to delivery in good condition. The problem in the caseous pneumonic type is more complex, depending to a great extent on the duration of the pregnancy when the tuberculosis is discovered and on the extent of the lesion. The later tuberculosis is diagnosed and treated the higher will be the mortality. The mortality in our series was 30 per cent in patients whose disease was diagnosed during pregnancy compared to 11 per cent in the group who were known to have tuberculosis before the onset of pregnancy. In the caseous pneumonic type prompt, adequate collapse therapy must be carried out at once and the pregnancy relegated to secondary importance.

Although no absolute routine is advocated since psychological, financial and sociological factors must be considered, experience has proved that our best results are obtained when we adhere to certain principles. Immediate termination of the pregnancy in all cases of caseous pneumonic disease with cavity formation discovered in the first trimester of pregnancy is urged. A dilatation and curettage under local, caudal or spinal anesthesia and prompt treatment of the tuberculosis with pneumothorax or thoracoplasty are instituted.

If the tuberculosis is discovered after the first trimester, the pregnancy is disregarded and the disease is treated as it would be in the nonpregnant woman. The few spontaneous abortions and premature deliveries we have seen when collapse therapy is carried out have been due to the fever and toxicity of the tuberculosis and have been known to occur in untreated tuberculosis as well as in any condition causing a high fever. We cannot condemn too strongly the practice of

waiting four or five months for the pregnancy to terminate before beginning collapse therapy for the tuberculosis. A number of cases have been reported^{3, 4} in which a thoracoplasty has been performed during the pregnancy and I have delivered a patient following a two stage thoracoplasty performed during the fifth month.

MANAGEMENT OF LABOR IN PULMONARY TUBERCULOSIS

Patients with exudative productive, chronic productive and arrested tuberculosis are permitted to go into labor provided there is no obstetrical contraindication. The indications for cesarean section are broadened, however, and in any borderline case of contracted pelvis section is performed in preference to risking a prolonged, tiring labor. As an analgesic we have found *oembutal* most satisfactory. Delivery is done under local or caudal anesthesia and the second stage terminated by forceps as soon as the os is fully dilated.

The patient with caseous pneumonic tuberculosis must be evaluated more carefully. No one can accurately judge before the onset of labor how long or how tiring the labor will be. Multiparas whose disease has been controlled for six months or longer are permitted to go into labor and watched very carefully. In patients with moderately and far advanced tuberculosis in whom the disease is not controlled, the method of delivery is decided upon at term or early in labor. Multiparas who, it is judged, will deliver in a few hours, are delivered vaginally, using forceps in the second stage. Primiparas should have a cesarean section under local or spinal anesthesia.

ANALGESIA AND ANESTHESIA IN LABOR

No analgesic that depresses respiration to such an extent that the pulmonary secretions flow back to the alveoli rather than through the bronchial tree should be used. If labor is progressing satisfactorily and the patient does not complain too bitterly of pain, no analgesic is employed. When analgesia is indicated, we have found *nembutal* in 3 grain doses best. Alexander⁵ states, "The preoperative use of narcotic doses of such drugs as morphine, *scopolamine*, *amytal* and *avertin* abolishes or greatly diminishes the cough reflex and the function of voluntary expectoration not only during the operation but for a varying number of hours afterward. During this time stasis of pulmonary secretions may cause the development of new areas of infection within the lungs."

We do not use inhalation anesthesia at delivery in the tuberculous patient. Local, caudal or spinal anesthesia is employed. Concerning

anesthetic agents Alexander states, "Ether, chloroform, amytal and avertin are more dangerous than local or gas anesthesia from the point of pulmonary complications because of the relatively prolonged postoperative unconsciousness they produce, during which time the patient does not cough or expectorate efficiently"

POSTPARTUM CARE

Following delivery the infant is removed from contact with the mother unless her sputum has been negative for at least six months and her disease is considered arrested or well controlled. In over 250 infants born of tuberculous mothers none was born with tuberculosis. A longer period of bed rest (up to three months) for patients with arrested, exudative productive or chronic productive disease is advised. This period may be longer if the caseous pneumonic type is present, depending on the medical treatment. In no instance is the mother permitted to nurse her infant.

In some cases, even though the tuberculous woman goes through her pregnancy without a flare up, there is a breakdown several months or years later. Any change in her condition due to the pregnancy or labor will have become evident within six weeks of delivery, and any change after that time in all probability will be due to the patient's undertaking too much housework, caring for her newborn in addition to her other children, and neglecting her rest and diet.

SUMMARY

Pregnancy per se has no deleterious effect on pulmonary tuberculosis. The type and extent of the lesion as well as the obstetrical management are the determining factors in the ultimate course of the disease.

Every patient with tuberculosis complicated by pregnancy should receive active antepartum and postpartum treatment from both the medical and obstetrical viewpoints, and collapse therapy should not be delayed because of the pregnancy.

The indications for cesarean section should be broadened in this group of cases but those patients with arrested, exudative productive and chronic productive disease may be delivered vaginally provided the labor is not prolonged or severe. The second stage should be shortened by the use of forceps.

Nembutal is the analgesic of choice and the actual delivery should be done under local or caudal anesthesia. Following delivery a pro-

longed period of bed rest for several months is advised and the patient is cautioned against too much housework when she returns home

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COMBINED INTRAUTERINE AND EXTRAUTERINE PREGNANCY

GEORGE SCHAEFER, M D *

THE occurrence of heterotopic pregnancy is frequent enough to pose a diagnostic problem and yet rare enough to warrant report of a case

Coexisting extrauterine and intrauterine pregnancies may be divided into two groups compound and combined In the *compound type* the extrauterine pregnancy has usually preceded the intrauterine one and has remained quiescent after becoming partially absorbed Repeated intrauterine implantations may occur after the death of the extrauterine fetus In the *combined type* simultaneous implantation may occur within and outside of the uterus This is actually a binovular twin growing in the tube, rarely on the ovary, with the other ovum growing normally in utero This paper is concerned with the latter, or combined, group

The first case of a combined pregnancy reported in the literature was that of Duvcrney in 1708 He reported an autopsy at which he found an ectopic pregnancy in addition to a three months' intrauterine gestation Since that time, approximately 350 cases have been reported, the figure varying depending upon whether both compound and combined groups are included and whose statistics are used Neugebauer¹ reported a total of 244 cases in two series in 1913 In 1926 Novak² added thirty two cases to bring the total up to 276 In 1940 Mitra³ found 304 cases in the literature and in 1944 Studdiford⁴ reported 322 cases by adding to Mitra's figures and 368 cases by adding to Ludwig's⁵ Marten and Meyer⁶ quote Frank as stating that combined pregnancy occurs once in every 105 ectopic pregnancies and since ectopic pregnancy occurs about once in every 300 normal pregnancy the incidence of combined pregnancy is approximately one in every 30 000 pregnancies

The following case history is typical of that of a combined pregnancy in which the intrauterine pregnancy proceeded to term after rupture and removal of the extrauterine pregnancy

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CASE REPORT

Mrs D Z, a 30 year old, white, married woman, was referred by Dr Harry H Epstein because of vaginal spotting. Her past history was relevant in that she had contracted pulmonary tuberculosis in 1940 and was being treated weekly with artificial pneumothorax for a right sided lesion. Her pulmonary condition was controlled chronic pulmonary tuberculosis, moderately advanced with pneumothorax.

On September 9, 1943, she began to have painless vaginal spotting. Her last normal menstrual period had been on August 12, 1943, and prior to that her menses had been normal. She also experienced slight nausea and fullness of the breasts so that a diagnosis of threatened abortion was made and the patient was given pramone and phenobarbital and placed at complete bed rest. The bleeding stopped and the patient was allowed out of bed after five days.

On September 25, ten days later, she began to experience intermittent lower abdominal cramps, nausea and recurrence of the vaginal bleeding. These symptoms became progressively worse through the morning, but since she had no telephone she was unable to call for assistance. Fortunately, Doctor Epstein arrived to give her a pneumothorax treatment.

The uterus was irregularly enlarged to size of a five to six weeks' pregnancy, the left adnexa was exquisitely tender and contained a mass the exact size of which could not be determined because the abdomen was splinted on the left side and was very tender to palpation. A diagnosis of ruptured ectopic pregnancy was made and the patient was taken to the operating room immediately. An infusion of 3 per cent dextrose in saline was started in one arm and a transfusion of plasma in the other arm.

The uterus was very slightly enlarged and contained three fibroids, each of which measured 4 to 5 cm in diameter. Two were situated on the fundus of the uterus and one on the lower anterior uterine wall. The right tube and ovary were normal. As soon as the bleeding was stopped in the left broad ligament and tube, a transfusion of freshly citrated blood was begun in place of the infusion of dextrose.

The left tube and ovary with the cyst were removed. No other operative procedure was done and the patient left the operating room in good condition. Pathologic examination showed the tube to be ruptured and to contain many chorionic villi. The ovary was replaced by a serous cyst.

Three weeks later, at her first postoperative office visit, the patient complained of nausea and fullness of the breasts. Pelvic examination revealed the uterus to be enlarged to about the size of a two months' pregnancy. A Friedman test for pregnancy was reported positive, confirming the diagnosis of an intrauterine pregnancy.

From this time on her antenatal course was uneventful, she received weekly pneumothorax refills and her pulmonary condition remained unchanged. About two weeks before term, a cesarean section was done under spinal anesthesia and a normal male infant was delivered, weighing 6 pounds 10 ounces. The indication for the section was her pulmonary tuberculosis.

COMMENT

Both the extrauterine pregnancy and the intrauterine pregnancy were not remarkable, if considered separately. The interesting aspect is their simultaneous occurrence and the fact that the intrauterine pregnancy carried to term.

King⁷ collected 221 cases in which the duration of the intrauterine pregnancy was recorded and found eighty-eight cases that went to term. The duration of the extrauterine cases, of which 125 were recorded, was as follows: 107 or 85 per cent terminated in the first trimester, seven or 6 per cent terminated in the second trimester, and eleven or 9 per cent terminated in the third trimester with eight of these patients, or 6 per cent of the total, going to term. Moore and Sale⁸ reported a case of extrauterine and intrauterine fetation occurring conjointly, with operation therefor resulting in death of the mother and saving of two living children. This case was further distinguished by the fact that the intrauterine infant had congenital lues whereas the extrauterine infant was normal.

Combined pregnancy presents a diagnostic problem. Frequently following spontaneous abortion of the intrauterine pregnancy one may be misled into a false diagnosis of an incomplete abortion thus overlooking the extrauterine pregnancy. As in Studdiford's⁴ case such diagnoses as infected fibroid, tubo-ovarian abscess, infected or twisted ovarian cyst and pelvic inflammatory disease were entertained until a laparotomy was done and the extrauterine pregnancy discovered. Fortunately, the ectopic pregnancy is usually the one that gives the symptoms since the tubal pregnancy ruptures and comes to early diagnosis and operation. Only 8 per cent in Novak's series of 276 cases were correctly diagnosed. The common error has been to overlook the intrauterine pregnancy. However, in any operation for ectopic pregnancy if the uterus is enlarged beyond the size of a six weeks' gestation one should suspect a coexisting intrauterine pregnancy. When no external bleeding occurs in an ectopic pregnancy one should think, also, of a combined pregnancy. One may be misled when doing a diagnostic dilatation and curettage in a case of possible ectopic pregnancy by the finding of placental and fetal products, and so overlook the concomitant ectopic pregnancy.

SUMMARY

A case of combined extrauterine and intrauterine pregnancy has been described. The extrauterine pregnancy manifested the usual clinical signs and symptoms and was treated as such, with the discovery three weeks postoperatively of a coexisting intrauterine pregnancy which continued to term. Combined pregnancies occur frequently enough to make one suspect this condition in all ectopic pregnancies in which the uterus is enlarged or there is no external bleeding.

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THE SURGICAL CLINICS of NORTH AMERICA

LAHEY CLINIC NUMBER

SYMPOSIUM ON TUMORS

PARATHYROID TUMORS

FRANK H. LAHEY

UNDER parathyroid tumors need to be considered only four types of lesions arising from these small, gland like structures (1) discrete, nonhyperfunctioning adenomas of the thyroid, (2) cystic degeneration within such an adenoma, producing a cyst of the parathyroid, (3) the hyperfunctioning parathyroid adenoma, and (4) localized malignancy in the neck arising from a parathyroid

In an experience now dealing with close to 26,000 thyroid operations, it must be realized that many normal and abnormal parathyroid glands have been dealt with. In this series and in a good sized series of cases sent to us with a clinical diagnosis of hyperparathyroidism, all of these varieties of parathyroid enlargements have been found. In addition to this, because we have been interested in preserving

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istic appearance of normal and abnormal parathyroid glands and, of particular importance, we have become familiar with their variations in location, something which is of extreme importance if one is to undertake the discovery of all hyperfunctioning adenomas in patients with hyperparathyroidism.

APPEARANCE OF NORMAL PARATHYROIDS, THEIR MOST FREQUENT LOCATION WHEN IN NORMAL POSITION AND THEIR POSSIBLE LOCATION WHEN IN ABNORMAL POSITIONS

We have operated upon a few patients for local tumors of the neck in whom the diagnosis was not certain but in whom the pathologic report following a removal has been a cyst arising in a nonhyperfunctioning parathyroid adenoma. We have likewise removed a few

discrete, good sized adenomas of the parathyroid gland which were not producing any symptoms or signs of hyperparathyroidism.

We have also removed localized tumors of the neck because of a suspicion of a malignancy and had the pathologic report returned as carcinoma originating in a parathyroid. Finally, we have reported previously on our experience in operating upon patients for hyperparathyroidism, particularly with hyperfunctioning parathyroid adenomas.

The diagnosis of primary carcinoma in the neck originating in a parathyroid gland will always be made by microscopic examination unless there is associated with this lesion symptoms of hyperparathyroidism which will not be true of the majority. This will likewise, as already stated, be true of the nonhyperfunctioning adenomas and cysts. When, however, patients come to the clinic with hyperparathyroidism and an operative procedure must be undertaken to discover the hyperfunctioning parathyroid adenoma, it becomes of the utmost importance to be familiar with the appearance and the probable location of the normal parathyroid glands. The reason for this is that unless the hyperfunctioning parathyroid adenoma can be demonstrated immediately, it is of value, as was suggested by Dr. Oliver Cope, to attempt to locate first the normal parathyroids in order to account for those and then have some idea at what level the missing gland is located.

While in the place of the four parathyroid glands which are usually present, there may exist only three or two, this is always a difficult statement to prove since one can never be sure in the living subject that failure to demonstrate the gland is real evidence of its absence, since it is extremely difficult, particularly in the parathyroid situated at the lower pole to demonstrate its presence. In most instances it has been our experience that four parathyroid glands are present, two at the upper pole and two at the lower pole. These glands, the two at the upper pole, are most constantly situated at the point where the upper lobes of the thyroid rest against the larynx in relation particularly to the horn of the thyroid cartilage. The demonstration of these two glands is possible in most instances only when the upper pole of the thyroid has been freed by ligating the superior thyroid artery detached from its attachments to the larynx at this point, and so rolled downward and inward that the posterior aspect of this portion of the lobe can be turned forward and the structures behind it visualized. This parathyroid is much easier to demonstrate than the lower gland since the upper parathyroid at that level is not surrounded by fat, is not covered by the branches of the inferior thyroid artery and vein as is the case with the lower gland, and also in its demonstration the recurrent laryngeal nerve as is the case with the lower gland, is not jeopardized. The two parathyroid glands in this superior region vary greatly in their degree of superficialness. Some are di-

rectly under the edge of the thyroid as the upper pole is turned down, some are well behind the upper pole, resting against the trachea and even under that portion of the thyroid which is described as the body of the thyroid.

The inferior parathyroids, in most instances, are often not easy to demonstrate. Not only are they difficult to demonstrate, but in their demonstration it is easy to interfere with their blood supply which comes from branches of the inferior thyroid. The inferior parathyroids are difficult to demonstrate because they are so frequently within the

and delicate structures. In addition to this, the inferior parathyroid glands are difficult to demonstrate because this region is not only rich in fat, but at this region of the thyroid, which has been described as the hilum, there exist also lymphoid and thymic tissue in small gland like masses, which can easily be confused with a parathyroid gland or cover it up. While it is true that the inferior parathyroid glands will stand out quite plainly in occasional cases, in the majority they will be so deeply buried behind the body of the thyroid at this level that they will be much more difficult to demonstrate than the superior parathyroid.

When one discusses location of parathyroids mention should always be made of the fact that we have found them in almost every conceivable position.

We have described abnormal locations of parathyroid glands in previous articles on this subject. We have seen parathyroid glands completely free from the thyroid and outside its course, particularly as relates to the lower parathyroids. We have seen parathyroid glands on the anterior surface of the thyroid. We have seen the superior parathyroid glands along the inner aspect of the upper lobe as it runs down to the isthmus and as the branch from the superior thyroid artery runs down in this direction in this region also. We have seen parathyroid glands on and in the body of the thyroid, upon the isthmus of the thyroid, behind the isthmus of the thyroid, and we have seen them entirely free from the lower lobe and within the areolar tissue beneath the clavicle, and, of course, have seen and removed parathyroid adenomas from within the mediastinum itself, into which they have doubtless progressed from original parathyroids detached from the isthmus and supplied by long branches of the inferior thyroid artery.

For a number of years we have searched every specimen of thyroid removed (1) to demonstrate whether or not we were removing parathyroids, (2) to familiarize ourselves with what normal para-

thyroids look like, and (3) to implant any removed parathyroids found upon the specimen into the left sternomastoid muscle. We make no claim that this implantation will be successful, but this procedure has given us a large experience with identifying, both as to location and character, normal parathyroids.

We have made certain of the identification in these cases by sending one-half of the suspected parathyroid to the laboratory for a histologic report, and transplanting the remaining half, thus having positive knowledge in each case as to whether or not the suspected gland was a normal parathyroid.

In addition to the above, we have kept a record each year of each surgeon's experience in the clinic, from these histologic reports as to the number of cases in which his specimens have shown removed normal parathyroid glands, thus creating a record available to all of the surgeons in the clinic as to how able they have been, with care as to these structures, in preserving them, just as we have with injuries to recurrent laryngeal nerves.

As a result of this experience, we have become quite familiar with the appearance of a normal parathyroid gland. The normal parathyroid varies greatly in size and even in shape, from a small gland like structure not much larger than the head of a match up to a gland the size of a pea bean. The normal parathyroids also vary greatly as to their color, but in the main have a distinctive light mahogany yellowish brown color which is quite different from the color of the

ing them as structures separate from the thyroid

Normal parathyroid glands can be further identified in most of the cases by the fact that they are flat, disk like structures, characterized by their molded edges not unlike the molded edges of a small lima bean, and the fact that their anterior surface is moderately convex while their inner surface is moderately concave. In general, they have somewhat the outline of the kidney except for their disk like flatness. In other cases they will have some of the roundness of a pea bean, although this is a much less common shape for them to possess than the flat disk like character, described above. On magnification, their surface is smooth, homogeneous and characterized by the easily visualized vessels distributed throughout their surface area. They are further characterized by the fact that they have a glistening capsule quite unlike the capsule of the thyroid and by the fact that they are movable upon their base, which is so often the true thyroid gland from which they can be demonstrated as separate entities. Due to the fact that the enlargement of the thyroid will occasionally pull upon these glands, they may be so elongated that they are literally four times their length as opposed to approximately twice their width in most cases.

It should be
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of the fact that the glands are either not functioning at all or are underfunctioning because most of the parathormone which the patient requires is being manufactured by the hyperfunctioning adenoma. As a result of this, the inactive glands may frequently be filled with fat pale in color, and not fulfill the requirements of the description stated above.

In most instances it will be possible to find hyperfunctioning parathyroid adenomas without difficulty if they are not within the mediastinum, but if they are not readily demonstrable, it is of great value if possible to be able to identify the three normal parathyroids (Cope) in order that one may have definite indications as to the possibility of the remaining unfound parathyroid gland involved in the hyperfunctioning adenoma and thus have indications for exploring the mediastinum.

adenomas in a more easily accessible region

Early in Dr. Cattell's service with this clinic, while he was still a fourth year student in Harvard Medical School and assigned to me under the tutelage system, he was able to demonstrate the not infrequent occurrence of the superior parathyroid within the thyroid substance. Because the superior parathyroid is behind the lobe as it rests laterally against the side of the larynx, it can as it becomes the site of an adenoma, mold a bed for itself into the substance of the thyroid here and during these examinations he demonstrated the frequent intrathyroid presence particularly of the superior parathyroid glands.

In some of the patients upon whom we have operated for hyperparathyroidism in whom previous exploration had been done elsewhere for hyperfunctioning parathyroid adenomas, we have successfully found and removed small parathyroid adenomas within the sub

the thyroid region had been unsuccessfully explored by an excellent surgeon, I was greatly aided by first finding the three normal parathyroids, and then carefully exploring the remaining one to demonstrate the presence of this vessel, obviously supplying the parathyroid adenoma located in the mediastinum. Because this vessel directed my attention to this low lying parathyroid aden-

oma, I was able to enucleate it from the mediastinum without splitting the sternum, and with complete relief of symptoms. As I have already stated, I do not believe that the mediastinum should be explored for hyperfunctioning parathyroid adenoma until every possibility of its discovery outside of the mediastinum has been exhausted.

DIAGNOSIS OF HYPERPARATHYROIDISM

fibrosa cystica, and up to those of complete bony decalcification so that only the outlines of the bones can be demonstrated by the roentgenogram

This disease, so provable by the effect of mobilization of skeletal calcium as the result of the increased production of parathormone and the resulting high blood calcium and high urinary output, described as a negative balance, is characterized by a typical chemical picture—a high blood calcium, a low blood phosphorus and a high phosphatase. The normal findings are blood calcium, 9 to 11 mg per 100 cc, phosphatase alkaline, 1.5 to 4 Bodansky units, phosphatase acid up to 1 unit, and blood phosphorus 2 to 4.5 mg. per 100 cc.

In typical cases with all the positive chemical findings plus the

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could be made at an earlier stage if more frequent studies of blood calcium were done as part of general chemical studies of patients having routine physical examinations

It is unfortunate when the diagnosis of hyperparathyroidism is delayed until such decalcification has taken place that spontaneous fractures have resulted, that vertebral body collapse with the typical round back which goes with this has taken place, that varying degrees of osteitis fibrosa cystica are present or until such has been the

adenoma has been removed and recalcification has taken place

It would be very much more satisfactory in the management of these cases if, as occurred in a recent experience with us, they could be discovered by early demonstration of elevated blood calcium be-

fore a prolonged negative calcium balance had so decalcified the skeleton as to produce the described changes

One should be suspicious of the presence of a hyperfunctioning parathyroid adenoma when, upon roentgenologic examination any evidence of bone rarefaction is present. If any generalized bone rarefaction is present, one should be suspicious when any localized tumor about the thyroid can be demonstrated similar in character to a discrete adenoma. In all such cases a blood calcium should be determined against the possibility that movable tumors, particularly in the region of the upper or lower pole of the thyroid, can and occasionally have been in our experience parathyroid adenomas with early degrees of hyperactivity. One should be suspicious of any patient with a round back and evidence on the roentgenogram of generalized collapse of the vertebral body. One should, of course, be extremely suspicious of any patient in whom a spontaneous fracture has occurred and one should be suspicious of the presence of hyperparathyroidism in all patients with kidney stones or calcification within the kidney.

While the truly typical case of hyperparathyroidism will have a conclusively high blood calcium at the level of 16 or 17 mg per 100 cc, and level of 15 mg per 100 cc, and level of 6, 7 or 8 Bodansky units,

the case will frequently not be this simple. It may even require putting the patient in the hospital on a carefully controlled diet and the establishment of the presence or absence of a negative calcium balance.

An early and relatively easy test as relates to calcium balance is the Sulkowitch test, with which at least to investigate the patient for the possible presence of a high blood calcium and a negative calcium balance. In the Sulkowitch test 2 cc of urine, which must be acid, is added to an equal amount of Sulkowitch reagent and the turbidity developed in two minutes is read qualitatively. The turbidity is due to the precipitation of calcium as calcium oxalate whereas the alkaline earthy phosphates remain in solution. The urine should be collected from a patient on a diet free from milk or acidifying agents, since they increase the calcium excretion in the urine.

TREATMENT OF HYPERPARATHYROIDISM

In most cases, with good light and good anatomical dissection of the thyroid gland with its upper poles detached by severing the superior thyroid artery and vein and turning it down, with the thyroid gland liberated from the internal jugular by severing and ligating the superior, middle and inferior thyroid veins, parathyroid adenomas can readily be discovered and removed. Even in those cases in which the adenoma is within the mediastinum, by the employment of the measures described, these tumors can be found and removed successfully.

One of the important things to remember in the management of the patient with hyperfunctioning parathyroid adenoma and well established hyperparathyroidism is the fact, as has been mentioned in the discussion of the color and shape of normal parathyroid glands, that most of the production of parathormone is carried on by the hyperfunctioning parathyroid adenoma, with the result that the remaining parathyroids are relatively inactive, and following the removal of the very overactive parathyroid adenoma, the remaining glands are frequently incapable of producing enough parathormone to maintain the patient in adequate parathyroid balance. It is for this reason that we have warned of the probable appearance of tetany following the removal of the hyperfunctioning parathyroid adenoma, as has occurred in a considerable number of our cases. Unless one is on the lookout for this tetany which so frequently occurs following the removal of the hyperfunctioning parathyroid adenoma, patients will be permitted unnecessarily to go through the emotional ordeal of tetanic seizures, which to everyone is quite frightening.

In the January, 1945 issue of the Bulletin,³ a case of hyperparathyroidism, in which the parathyroid adenoma was successfully removed, was reported to demonstrate how rapidly the blood calcium could drop and how long it took for the remaining parathyroids to recover their ability to produce an adequate amount of parathormone to maintain calcium balance within a normal range.

This patient's blood calcium on the night before operation was 16.3 mg per 100 cc., on the morning of the day after operation it had dropped to 12.5 and on the second day after operation it had dropped to 8.5 mg., with early signs of tetany. This was due, as stated previously, undoubtedly to the fact that the three remaining parathyroids had been relatively so inactive for such a long period of time that they were incapable of resuming activity rapidly enough to meet the parathormone demands of the body.

It was of further interest in this patient to demonstrate that it was necessary for her to receive calcium for a period of at least two months before her remaining parathyroids had recovered sufficient function to supply an adequate amount of parathormone with which to keep the patient in calcium balance.

Finally, in dealing with patients with hyperparathyroidism one should never fail to remember that following removal of the hyperfunctioning parathyroid adenoma decalcification will cease, blood calcium levels will be restored to normal and recalcification of the demineralized skeleton will take place. It is therefore, of the utmost importance, as we have frequently suggested, to call upon the orthopedist to support these patients in as nearly adequate positions as possible in order that they may recalcify their skeletons in these positions and not in the often exaggerated positions of deformity which result from the skeletal decalcification which occurs with this disease.

SUMMARY AND CONCLUSIONS

In conclusion, tumors of the parathyroids, then, are the discrete nonhyperfunctioning adenomas, the adenomas which have become cystic, the hyperfunctioning adenomas and the rare primary carcinomas of the neck which are found on microscopic examination to be of parathyroid origin

It is suggested that the Sulkowitch test be done more frequently to determine the possible presence of hyperparathyroidism at an
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able appearance of tetany following the removal of hyperfunctioning parathyroid adenomas and the suggestion made that frequent blood calcium tests be done postoperatively. In the presence of any low blood calcium postoperatively, the patient should be placed upon calcium, A T 10 or parathormone and carried on maintenance doses until evidences of tetany are no longer present and it is demonstrated that the patient's remaining parathyroids are able to carry on their function adequately

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In conclusion, tumors of the parathyroids, then, are the discrete nonhyperfunctioning adenomas, the adenomas which have become cystic, the hyperfunctioning adenomas and the rare primary carcinomas of the neck which are found on microscopic examination to be of parathyroid origin

It is suggested that the Sulkowitch test be done more frequently to determine the possible presence of hyperparathyroidism at an earlier date than the diagnosis has often been made in the past

Measures are suggested by which hyperfunctioning parathyroid adenomas can be discovered and warnings stated as to the very probable appearance of tetany following the removal of hyperfunctioning parathyroid adenomas and the suggestion made that frequent blood calcium tests be done postoperatively. In the presence of any low blood calcium postoperatively, the patient should be placed upon calcium, A T 10 or parathormone and carried on maintenance doses until evidences of tetany are no longer present and it is demonstrated that the patient's remaining parathyroids are able to carry on their function adequately

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TUMORS OF THE NECK

FRANK H. LAHEY

ANY discussion of tumors of the neck will be simplified if this group of tumors is divided into (1) those tumors that arise in the mid line, (2) those tumors arising laterally, and (3) tumors which are single and discrete and tumors which are multiple.

MEDIAN LINE TUMORS

It is important to divide all neck tumors primarily into median line tumors because these tumors are limited to those of thyroid origin, exclusive of the occasional discrete adenoma arising in the isthmus and either projecting forward between the two bellies of the sternomastoid or descending into the median line behind the sternum, and are, for practical purposes, related to the descent of the thyroid.

As one recalls the origin of the thyroid, represented in the adult by the foramen cecum at the base of the tongue, it will be remembered that the thyroid is originally connected to the alimentary canal in fetal life. The foramen cecum represents this embryonic connection. The thyroid starts at the base of the tongue, descends through the tongue, and usually behind the hyoid bone. If fusion of that structure is delayed until thyroid descent has already taken place in the thyroglossal tract which is the remnant of the fetal thyroid connection with the alimentary canal, it is included in the hyoid bone and may run directly through it. This is of importance in dealing with thyroglossal sinuses since complete eradication of such a thyroglossal tract, if open, can be accomplished only by excision of that median portion of the hyoid through which, under this circumstance, it runs. As the thyroid descends from its fetal position at the base of the

191, 192) can be a lingual goiter, enlarging within the substance of the tongue. It can be an intralingual goiter, enlarging within the substance of the posterior third of the tongue. It can be a sublingual goiter, descending just below the tongue and projecting from beneath the tongue and above the hyoid bone.

In our experience now with over 25,000 patients with goiters we have seen three lingual goiters. They are to be diagnosed by their median positions, by their increase in size over the years and by the inability to palpate any thyroid tissue in the normal position.



Fig 191—This is a roentgenogram taken laterally to show the projection of a lingual goiter on the back of the tongue. Note how low these descend in relation to the hyoid. This was removed through the mouth and the specimen is shown in Figure 192.



Fig 192—The lingual goiter shown in Figure 191. Note the size of this tumor which was removed without difficulty through the mouth. This patient, as will occur in all of these cases, developed myxedema.

TUMORS OF THE NECK

FRANK H. LAHEY

ANY discussion of tumors of the neck will be simplified if this group of tumors is divided into (1) those tumors that arise in the mid line, (2) those tumors arising laterally, and (3) tumors which are single and discrete and tumors which are multiple

MEDIAN LINE TUMORS

It is important to divide all neck tumors primarily into median line tumors because these tumors are limited to those of thyroid origin, exclusive of the occasional discrete adenoma arising in the isthmus and either projecting forward between the two bellies of the sterno-mastoid or descending into the median line behind the sternum, and are, for practical purposes, related to the descent of the thyroid.

As one recalls the origin of the thyroid, represented in the adult by the foramen cecum at the base of the tongue, it will be remembered that the thyroid is originally connected to the alimentary canal in fetal life. The foramen cecum represents this embryonic connection. The thyroid starts at the base of the tongue, descends through the tongue, and usually behind the hyoid bone. If fusion of that structure is delayed until thyroid descent has already taken place in the thyroglossal tract which is the remnant of the fetal thyroid connection with the alimentary canal, it is included in the hyoid bone and may run directly through it. This is of importance in dealing with thyroglossal sinuses since complete eradication of such a thyroglossal tract, if open, can be accomplished only by excision of that median portion of the hyoid through which, under this circumstance, it runs. As the thyroid descends from its fetal position at the base of the tongue to its normal location on the tracheal rings it leaves behind it a thyroglossal tract which normally is obliterated. It is this structure plus the failure of descent to the thyroid which brings about median line swellings (tumors and cysts) related to thyroid descent.

Lingual Goiter.—Under rare circumstances the thyroid gland fails entirely to descend and then is a lingual goiter. A lingual goiter (Figs 191, 192) can be a true goiter projecting on the posterior third of the tongue. It can be an intralingual goiter, enlarging within the substance of the posterior third of the tongue. It can be a sublingual goiter, descending just below the tongue and projecting from beneath the tongue and above the hyoid bone.

In our experience now with over 25 000 patients with goiters we have seen three lingual goiters. They are to be diagnosed by their median positions, by their increase in size over the years and by the inability to palpate any thyroid tissue in the normal position.

cartilage, the left location being more frequent than the right. Again, anyone who has operated upon many patients for thyroid disease will be very well aware of the fact that the pyramidal lobe of the thyroid



Fig 194—An exuberant granulation in the midline of a draining thyroglossal sinus. This patient had a thyroglossal cyst which was incised and drained in definitely until radically removed.



Fig 195—This is a surgical specimen of a thyroglossal cyst removed. Note the sinus tract at the left as indicated by the arrow and the section of hyoid bone removed on the right as indicated by two arrows.

more frequently runs to the left side of the median line and along the left plate of the thyroid cartilage than it does on the right side and, in addition, that they almost never extend upward directly in the

These tumors have, in our experience, required removal only when, because of pressure, they have interfered with swallowing. It is to be remembered that in every instance with which we have dealt they represent all of the thyroid tissue there is and following their removal the patient will be completely myxedematous.

In writing on this subject we have previously stated that these tumors are usually intralingual or supralingual. The intralingual and supralingual tumor can be approached successfully through the mouth by means of silk traction stitches placed in the tongue, wide exposure of the mouth and packing of the pharynx, intratracheal anesthesia,



Fig. 193—This illustration shows a typical thyroglossal cyst. Note the sinus at the bottom of the cyst where it has previously been drained and has filled up again.

incision such as is shown in Fig. 194, which exposure of the anatomy of the neck can accurately be demonstrated and the dissection anatomically and accurately executed in a dry field.

Thyroglossal Cysts and Sinuses—Thyroglossal cysts and sinuses (Figs. 193, 194 and 195) originating as they do in the thyroglossal tract, are always in the midline. The most frequent locations of a thyroglossal cyst are on the left or the right side of the thyroid

sternomastoid or the one which extends into the mediastinum. It is our opinion that all discrete adenomas of the thyroid because of the danger of malignant degeneration, irrespective of pressure upon the trachea, should be removed.

SINGLE, DISCRETE, MOVABLE, Laterally Located Tumors

The treatment of single, discrete laterally located tumors of the neck particularly of the movable type is important because of the fact that not a few of them are or become malignant. For practical purposes they are represented by the following group of



Fig 196—This illustration demonstrates a typical branchial cyst. Note that it has occurred in the portion of the branchial tract just beneath the skin and before it disappears beneath the posterior belly of the digastric muscle.

swellings: branchial cysts (Fig 196), carotid body tumors (Fig 198), single discrete lateral aberrant thyroid tissue (Fig 197) and neurofibromas.

Branchial Cysts and Sinuses—Perhaps the most common single discrete and movable swelling of the neck occurring in our experience is the branchial cyst (Fig 196). Just as the thyroglossal duct is a congenital remnant lined with secreting cells and normally one which is closed at birth, so the branchial sinuses represent the same developmental defect. They empty into the pharynx close to the tonsil, descend beneath the digastric muscle and from there just beneath the skin to discharge through a dimple just in front of the sternomastoid muscle and just below the level of the cricoid cartilage. They are frequently bilateral. There are frequent instances in which they

median line. From this it can be realized that as the pyramidal lobe represents the course of descent and development of the thyroid, so

level of the notch in the thyroid cartilage

Thyroid cysts occasionally will be in the median line above the notch of the thyroid cartilage where the thyroglossal tract passes behind the hyoid bone to its point of origin in the base of the tongue, the foramen cecum. These may frequently project as a tumor in the mid line just above the notch of the thyroid cartilage (Fig. 193).

Thyroglossal cysts represent, of course, a thyroglossal tract in part still patent, with closure on either end of the cyst and with accumulation of mucoid material within the cyst to produce the swelling.

most cases of thyroglossal cysts that we have seen here, and we have now operated upon 314 of these cysts and sinuses, is usually that of previous incision or incomplete excision with continuation of drainage.

Since we have for many years following the original suggestion of Sistrunk, done radical removal of a thyroglossal cyst and tracts in all patients with these lesions, consisting of complete removal of the cyst, complete removal of the central portion of the hyoid, and following of the cyst tract up to the base of the tongue, there have been no recurrences of these lesions.

Median Line Adenomas of Thyroid—There is one feature which should be discussed particularly concerning the median line adenomas of the thyroid which were spoken of earlier in this discussion, which descend behind the sternum, producing complete or incomplete median line intrathoracic goiter.

Most intrathoracic goiters are laterally located and are characterized by lateral deviation of the trachea. In discussing these lesions I have frequently called attention to the fact that as the patient turns his head away in sleeping, from the side to which the trachea is curved there will be increased pressure of the deviated trachea over the intrathoracic goiter which will so narrow it that the patient is frequently awakened and finds it difficult to breathe.

In the median line adenoma of the thyroid, arising from the isthmus which descends behind the sternum this will not be true but such patients will frequently complain that as they bend over or elevate their arms, choking results which is caused by the pressure of the median line isthmus adenoma backward on the trachea as the chin is flexed upon the chest or as the thoracic cage is elevated.

The treatment of median line adenoma of course, needs no discussion, either the type which bulges between the lower bellies of the

The best method of treating branchial sinuses is by a small, elliptical incision about the dimple of exit, elevation of the skin, subcutaneous dissection of the tract put on the stretch up to the point where it dis

just below the angle of the jaw. Through this it is possible to dissect the tract beneath the hyoid, to protect the hypoglossal nerve and to clamp the tract as it enters the pharynx at the level of the tonsil and cut it off.



Fig 197.—This illustration shows malignancy arising as a discrete tumor in a lateral aberrant thyroid. These tumors occur as multiple nodules or as single discrete nodules.

Lateral Aberrant Thyroid Tissue.—The next most common laterally located tumor of the neck is perhaps the single aberrant mass of lateral aberrant tissue (Fig 197). These are by no means common since in 25 000 goiters seen in this clinic they have occurred in but 47 cases. These lateral aberrant thyroids, originating as they do from the ultimobranchial bodies, as we have stated, are often single, discrete, movable, laterally located good sized tumors. When they are multiple, they are not difficult to diagnose since they run up or down in front of the sternomastoid muscles, being either unilateral or bilateral, in close relationship to the internal jugular vein. When, however, they occur, as they occasionally do, as a single discrete mass of lateral aberrant thyroid tissue, they are much more difficult to

have occurred in several children in the same family. We have had an instance in which both branchial tracts were so completely opened that ureteral catheters could be passed from their skin openings on either side of the neck in front of the sternomastoid upward through out the tract to emerge within the pharynx. This, however, has occurred in but one instance in my entire experience with these lesions.

When a tract is closed at both ends a "throatsore" . . .

... and because the tract below the level of the digastric is situated directly beneath the skin, the bulge is outward and not inward as they enlarge (Fig 193). This feature is to be borne in mind since it is in contradistinction to the tendency of carotid body tumors to grow inward and upward, limited as they are by their position in the notch made by the external and internal carotids (Fig 193).

These branchial lesions, explaining as they do, primary carcinoma of the neck, originating so often from branchial tracts, should be removed. They should be removed because the cysts tend to become larger and can be removed with no danger to adjacent structures.

Branchial sinuses are frequently demonstrable in children, as small dimples which ascend and descend on swallowing so that they pucker the skin due to the fact that their attachment to the pharynx and their fibrous wall, with deglutition, pulls upon the sinus tract and so *dimples the skin* as it is pulled upward. Not infrequently, also, these small exits where the tract emerges in the skin are characterized by flecks of pigmentation by which they can be distinguished.

The long branchial sinus tracts may be easily palpated under the skin as cord like structures. If one will push down upon the exit dimple so that the sinus is put upon the stretch, the tract can readily be palpated throughout its course, so that in its removal the tract can be successfully traced to the point where it passes beneath the digastric to become attached to the pharynx.

... losing these sinuses by the in-
Carnoy's solution made up of
... glacial acetic acid 1 cc. and
ferric chloride 1 gm. This is, however, to my mind a far inferior method of treating these lesions than simple excision by means of the so-called stepladder incision, first proposed, I believe, by Hamilton Bailey, of London. The disadvantages of injecting sclerosing solutions are that sinus tracts do not always permit easy injection, there is the danger of reaction and following their obliteration there will always be the dimpling of the skin as the child or adult swallows and the sclerosed tract retracts the skin at the point of emergence of the tract.

of the thyroid vessels, which they almost never do. One of the diagnostic features of these tumors is that they cannot on traction be made to descend because of the fact that their descent is limited by their origin in the notch made by the external and the internal carotid vessels.

It is to be recalled also that unlike branchial cysts and single lateral aberrant thyroids, these tumors are deeply located as is the division of the common carotid. It is to be recalled that their enlargement is usually in the upward direction toward the base of the skull and inward toward the pharynx.

As we have stated in a recent discussion of these tumors, in 2 of our patients operated upon for carotid body tumors the extension into the pharynx was of such degree as to necessitate an immediate operation because of the fact that they were interfering with swallowing and so interfering with nutrition.

Carotid body tumors are difficult to manage because in not a few instances the tumors exist not only in the notch made by the external and internal carotid vessels, but completely surround it and their successful removal would necessitate ligation of the common, internal and external carotids.

Ligation of the common, external and internal carotids, in spite of the fact that we have demonstrated some of these patients to be able to endure ten minutes of compression of the common carotid three times a day without symptoms, has in 2 cases resulted in fatalities. Such is the hazard of this procedure that we are convinced that when

One of the as yet undetermined factors of carotid body tumors is the accurate percentage of malignancy which occurs in them. It has been reported by Harrington, Clagett and Dockerty that their incidence of malignancy was as high as 50 per cent. Other authors have reported the incidence of malignancy as 20 per cent. In the 18 carotid body tumors which we are presenting in the paper spoken of on this subject, there was no malignancy, and so, in carotid body tumors we believe that removal should be predicated on the ability to dissect tumors free with safe and complete preservation of the integrity of the common, external and internal carotids. Under these circumstances we believe that removal is justifiable and on failure to be able to do this, is not justifiable.

Neurofibroma.—Still another tumor which, of course, occurs everywhere, and is devoid of any characteristic symptoms, is the neurofibroma. We have operated upon several patients with neurofibromas of the neck. They have no special characteristics, they are diagnosed almost always solely at microscopic examination and can occur at any point where nerve tissue is present.

diagnose and their true nature can be determined only by microscopic examination. They are superficial in character, they project in front of the sternomastoid, they are located laterally, often at the level of the superior thyroid artery or a little above. They are firm and solid on palpation. They are dangerous as relates to delay in their removal because of the fact that in our experience with 47 patients with lateral aberrant thyroids upon whom we have operated, 9 were malignant and 2 patients have died. These tumors are all papilliferous in character, easily demonstrated as to their origin on microscopic study and their type of malignancy when it occurs is the papillary adenocarcinomatous character. On radical removal, followed by high voltage x-ray therapy, since they are extremely radiosensitive, these patients do well. It is for this reason that all laterally located discrete tumors



Fig. 198.—This illustration shows a carotid body tumor. Note the deeper location since, as stated in the text, its origin is in the carotid notch and its tendency is to grow upward under the angle of the jaw and inward.

of the neck should be removed early because of the possibility of this diagnosis and the occurrence of malignant degeneration.

Carotid Body Tumor.—One of the rare tumors of the neck is the carotid body tumor (Fig. 198). Since in the last fifteen years, there were only 300 of these cases reported in the literature, we are reporting in an article soon to be published an experience with 18 carotid body tumors. Unlike branchial cysts and aberrant thyroids, carotid body tumors are constant in their location as to their level, since they must arise in the carotid body, in its constant location at the notch made by the division of the common carotid into the external and internal carotids. These tumors, limited as they are by this origin, must enlarge upward and usually inward toward the pharynx. They can descend only if during their enlargement they escape from the notch.

thoracic duct. These can be single and movable, but have frequently progressed to large, fixed, broad based masses extending beneath the clavicle and so spreading out that no lower limitation can be palpated. There are a few metastatic glands of the neck secondary to carcinoma of the lung and stomach occurring as discrete masses of glands in the mid lateral portion of the neck, but they are much rarer than the low glands above the clavicle which start originally in a Virchow's gland.

There occasionally occur *primary carcinomas* of the neck arising from branchial remnants or of parathyroid origin.

Inflammatory glands secondary to infected areas elsewhere are not difficult to diagnose. They are of recent origin and so are often related to demonstrable infected lesions within areas which they drain.

Deep Cervical Abscesses.—Deep cervical abscesses consist of masses of inflammatory exudate beneath the deep cervical fascia,

which can be demonstrated as the probable origin of the sec-

can occur in great variety and location. The discrete adenomas most commonly occur in the lateral lobe of the thyroid. Multiple adenomas occur in one lateral lobe, in both lateral lobes or in both lateral lobes and isthmus. It is to be remembered that adenomatous goiter can laterally involve the complete neck from the clavicle to well up under the angle of the jaw, that adenomatous goiters can extend not only into the mediastinum but can extend behind the larynx and become completely retrolaryngeal. We have in fact several times seen an adenomatous upper lobe of the thyroid extend behind the larynx,

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There are a few features about intrathoracic goiter which charac-

One must recall, of course, that *lymphosarcoma* or *Hodgkin's disease* and *cystic hygromas* can and occasionally do occur as a discrete tumor or cyst. This is, however, rare. They possess no peculiar qualities by which they can be distinguished and are diagnosed usually only at the time of histologic examination.

MULTIPLE TUMORS AND CYSTS OF NECK

When one discusses the multiple tumors and cysts of the neck the problem becomes infinitely more intricate as to number, variety and difficulty of diagnosis. The multiple tumors and cysts of the neck, for practical purposes, consist of tuberculous cervical lymph nodes, Hodgkin's disease, metastatic glands of the neck originating so frequently from carcinoma of the lung or carcinoma of the stomach, multiple lateral aberrant thyroids, deep cervical abscesses, discrete extrathoracic and intrathoracic adenomas of the thyroid and cystic hygromas.

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terized by a few quite typical

are most often at the middle level of the neck, they frequently become necrotic and on roentgenologic examination, because of caseation, calcification can often be demonstrated in them.

The absolute diagnosis of tuberculous cervical adenitis can, of course, be made only by the demonstration of the organism or by microscopic section.

Most patients with tuberculous adenitis of the neck can today be quite satisfactorily treated by irradiation except those patients in whom abscesses have formed. Even in these, incision and drainage followed by irradiation will in most instances take care of these lesions in our experience.

Hodgkin's Disease.—Hodgkin's disease of the glands of the neck is outstandingly the diagnosis first to be considered in all cases of multiple tumors of the neck, particularly when they are noninflammatory in character and are not necrotic. These are characterized by being multiple, by being grape like, movable structures in the beginning although they can be fused together and can have secondary inflammatory reactions in them. They are diagnosed positively only by microscopic examination.

Metastatic Malignant Glands of Neck.—Metastatic malignant glands of the neck occur in two locations, the most common of which are the low glands above the clavicle which have been described under the term of Virchow's glands. A Virchow gland is a gland behind the left internal jugular vein, usually secondary to a carcinoma of the stomach which has ascended along the course of the

be operated upon. If they are still benign and have not as yet become papillary adenocarcinomas, a radical removal of the gland-like structures up and down the neck may be done without removal of the internal jugular but with removal of the lobe of the thyroid on the side of the neck in which they occur.

It is important to remove the lobe of the thyroid on the side in which they occur because the thyroid and the ultimobranchial body are in such close relationship that the lateral aberrant thyroid frequently fuses with the thyroid in its development, and the papillifer



ous tumor which characterizes lateral aberrant thyroid can exist within the lobe of the thyroid and have all the dangers of malignant degeneration in it.

nodes and the lobe of the thyroid on that side should be removed and the patient should be given irradiation with high voltage x ray therapy postoperatively. As already stated since these tumors are extremely radiosensitive, most of these patients can be carried over

terize them and differentiate them from other intrathoracic tumors. One is their tendency to exist on one side of the trachea. If one will recall the appearance of the trachea, the esophagus and vertebral bodies in a cross section of the body at the level of the superior mediastinum, he will recall that the vertebral bodies, the esophagus and trachea stick out like a ridge pole and that as the tumor passes into the mediastinum through the upper thoracic strait in most instances it will be on one side or the other of these projecting structures. For this reason most intrathoracic goiters deviate the trachea either to the right or to the left in contradistinction to the other tumors occurring within the mediastinum, such as dermoids or bronchogenic cysts.

The one outstanding feature which characterizes intrathoracic goiter or adenoma of the thyroid and that distinguishes it from other tumors within or without the mediastinum is the fact that it ascends and descends with swallowing. The only other type of tumor, either extrathoracic or intrathoracic, that ascends and descends with swallowing is a benign tumor of the esophagus, of which we have had 3 and which have been reported by Dr. Ralph Adams from this clinic.

Lateral Aberrant Thyroids.—A final group of tumors which are multiple in character have already been discussed. They are the lateral aberrant thyroids, already stated, arise from the lateral aspect of the thyroid gland, up and down in relation to the internal jugular. They vary in size from small gland like structures to large, multiple nodules or to single nodules as already discussed under the heading of single, laterally located tumors.

Treatment.—I have purposely refrained from discussing the treatment of all these lesions other than tuberculosis because of the fact that they fall very much under the same group as to the methods of treatment. Obviously, Hodgkins disease is not a problem for local removal unless it is causing pressure.

There is no surgical treatment for metastatic glands of the neck except again when they are local and one desires to remove them because of local symptoms.

One of the lesions which is by no means common in this region but is not to be overlooked is the *cystic hygroma* of the neck, a case of which is shown in Figure 199. This illustration demonstrates a cystic hygroma of the neck largely located in the submaxillary region. It is to be recalled, however, that a great many of these lesions involve the entire side of the neck and are to be suspected because of the fact that they contain fluid and are of fluid containing consistency.

I have already discussed multiple lateral aberrant thyroids and have called attention to the fact that the high percentage of these show malignant degeneration in the form of papillary adenocarcinoma. When these lateral aberrant thyroids are suspected they should all

TUMORS OF THE SUBMAXILLARY AND PAROTID GLAND AREAS

SAMUEL F. MARSHALL AND GEORGE O. MILES

INTRODUCTION

SINCE Virchow described mixed tumors of the parotid in 1863 much has been written about salivary gland tumors. These tumors though not common are far from rare; their incidence is given as 1 to 2 per cent of all tumors. Interest in this group has probably far exceeded their frequency of occurrence. This is the result of the fact that pathologists and surgeons are still not in full agreement about the histogenesis, classification and treatment of these tumors. The pathologist in selected cases has great difficulty in cytologic interpretation; the surgeon in many cases has a difficult decision to make regarding

maxillary areas likewise 28 salivary gland tumors occurring in other than the parotid and submaxillary areas were excluded.

Although tumors of the salivary gland are much more common in the parotid and submaxillary areas they also occur in the oral cavity, nasopharynx, accessory nasal sinuses, lacrimal gland and middle ear. In these regions the salivary gland tumor arises from the mucous glands of the mucous membrane covering the lips, alveoli, buccal surface of the cheeks, tongue, palate, pharynx and upper respiratory passages. In these locations the tumors are often referred to as of aberrant salivary gland origin, which is a misnomer since they arise not from aberrant structures but from constant anatomical components of the mucous membrane.

Table 1 lists the material reviewed in this report. It is noted that 100 benign mixed tumors are included. The 24 cases of cancer of the salivary gland form only 18 per cent of the true salivary gland tumors represented in this group. This proportion of cancer is somewhat lower than that given by some writers who report an incidence as high as 50 per cent.

Only 5 cases of adenolymphoma, also known as papillary cystadenoma lymphomatosum or oncocytoma, are included.

ma in origin
nodes of the
a generalized

neoplastic process. This possibility must always be considered in the

long periods of time, if not indefinitely, without recurrence. Again, as has already been stated, in reporting 47 of these cases operated upon in the clinic and followed, malignancy occurred in 9, and of the 9, 2 patients have died

CONCLUSIONS

In this discussion, tumors of the neck have been divided into those of median location, into those of lateral origin which are discrete and movable, and into those which are multiple in character

The proper diagnosis can be made in many of these cases, but in many others the final and correct diagnosis must be deferred for the reports of the pathologist

The possibility of malignancy of tumors of the neck is so great that an accurate diagnosis should be arrived at in all of them, either by the removal of the discrete tumor, if it is possible with safety, and its submission to the pathologist, and in the case of multiple tumors, by the removal of a single tumor for pathologic examination and determination as to the further course of treatment based upon the microscopic diagnosis

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The miscellaneous group of tumors is of interest chiefly as a problem of differential diagnosis. The preoperative diagnosis, with the exception of the 10 cases of inflammatory submaxillary gland, was parotid tumor. The majority of parotid tumors is easily identified. If the physical findings are not typical, however, one should consider in the differential diagnosis other tumorous swellings that are known to have mistakenly been called parotid tumors. Two of the three angiomas in this group were deep seated angio endotheliomas which may appear as firm masses in contrast to the cystic consistency of the more common cavernous variety. The other occurred in an infant of 2 years at which age angioma should always be considered in examination of any deep lying mass in this area. The sebaceous cyst in this group was described as a firm, fixed, pre auricular mass, possibly carcinoma. Sebaceous cysts are frequently seen in this region and usually present themselves as obvious intradermal cysts. The branchial cleft cyst reported in this area developed through the substance of the parotid gland. This presenting site for branchial cleft cyst has long been recognized but must be rare from its infrequent occurrence in reports on branchial cleft series. The parotid cysts noted in this group are presumably associated with inflammation and obstruction. Ranula, occurring in the floor of the mouth and associated with inflammation of the submaxillary gland, is a common example.

Parotitis is the most common non neoplastic swelling confused with parotid neoplasia. The surgeon should be suspicious of the typical mixed tumor, 3 cm in diameter or larger but of only a few weeks duration. Parotitis is usually tender to palpation, which is the most important differential sign, however when the patient is seen twenty five or more days after its onset and when the inflammatory process has become chronic and fibrotic, it may not be tender and may appear to the examiner to be a typical parotid tumor. Such inflammation may be low grade from the onset. When the surgeon recalls that parotid tumors not infrequently present beneath the pinna of the ear in the space between the angle of the mandible and the mastoid process, he must consider in the differential diagnosis other tumors that occur in this area. Hyperplastic and tuberculous adenitis, sarcoma metastatic carcinoma, branchial cleft cyst, schwannoma, and lipoma may occasionally suggest submaxillary or parotid tumors. Eight of the benign mixed tumors of the parotid in this series had at some time been regarded as hyperplastic adenitis before the patients came to the clinic. 2 of these patients had had respectively, a tooth extraction and tonsillectomy. One of the patients with parotid carcinoma had had a tonsillectomy when a physician was first consulted because of the appearance of the lump beneath the angle of the mandible. One of the frequent features of sarcoid is parotitis that on more than one occasion has been thought to be a parotid tumor.

differential diagnosis of an apparently mixed tumor of the parotid and submaxillary gland

The one case of neurofibrosarcoma of the facial nerve within the parotid gland is a rare tumor. This patient had nine operations over a period of ten years. The pathologic report was neurofibroma in all but one specimen, which showed neurofibrosarcoma. The last year that she lived, a rapidly growing, ulcerating tumor, 8 cm in diameter, was observed eight months after she had been clinically without evidence of disease.

TABLE 1

CLASSIFICATION OF TUMORS IN THIS GROUP

1 Parotid		
A Benign		94
a Mixed tumors	89	
b Adenolymphoma	5	
B Malignant		23
a Adenocarcinoma	8	
b Malignant mixed tumor	9	
c Epidermoid carcinoma	2	
d Lymphosarcoma	2	
e Hodgkin's disease	1	
f Neurosarcoma	1	
2 Submaxillary		
A Benign		11
a Mixed tumors	11	
B Malignant		1
a Hodgkin's disease	1	
3 Miscellaneous Tumors		18
A Parotid cyst	2	
B Branchial cyst in parotid gland	1	
C Angomas	3	
D Sarcoid	1	
E Pre auricular sebaceous cyst	1	
F Submaxillary inflammation	4	
G Submaxillary inflammation with calculi	6	
4 No Pathologic Diagnosis		3
Total		150

The group of tumors arising in the submaxillary gland is small and the only malignant process among this group is Hodgkin's disease. One possible reason for infrequent malignant tumor in this group is that the average duration of the submaxillary tumors before the patient came to operation was three and one half years; in only 2 patients was the tumor present over five years; in these two cases the tumor was present seven and nine years respectively. This duration may be compared with that of the 89 benign parotid tumor group whose average duration before operation was eleven years; in 22 cases or 24 per cent the tumor had been present from sixteen to forty years before the patients came to surgery at the clinic.

lymphoblastomas whose duration was three months, five months, eight months and nine years, respectively, were not included, the time elapsed before operation for this group would be even higher. The duration of tumor in the malignant group is shown in Table 4.

Table 5 shows this group in age decades at time of onset of tumor and operation for carcinoma.

TABLE 4
DURATION OF MALIGNANT TUMORS

Less than 1 year	10
1-5 years	5
6-15 years	4
16-26 years	4
Not stated	1

Many patients, in explaining delay of treatment of these tumors, tell us that they thought "if it wasn't bothering them they wouldn't bother it." This adage is frequently abused by both the patient and physician in regard to parotid and submaxillary tumors. The statement has also been made that all mixed tumors of the salivary gland

TABLE 5
AGE AT ONSET COMPARED WITH AGE AT OPERATION

	Tumor Appeared	Operation for Carcinoma
0-10 years	0	0
11-20 years	3	1
21-30 years	1	0
31-40 years	5	4
41-50 years	6	6
51-60 years	3	6
61-70 years	3	3
71-80 years	2	4

are potentially malignant might also state that they are the carcinoma come to surgery sooner, if the group noted rapid growth upon first appearance. Sudden increase in rate of growth preceding operation was noted in several of the carcinomas and mixed tumors that had been unchanged in size for years.

PRESENTING SYMPTOMATOLOGY

In reviewing records in an effort to evaluate symptomatology, there are, no doubt, many errors of omission. One may note only the most significant points. Table 6 depicts only generalities in analysis of presenting symptoms.

Excluding the miscellaneous group 55 histories of patients with

The following discussion will be directed chiefly toward the true benign and malignant salivary gland tumor of the parotid and submaxillary gland

INCIDENCE

Of this group, 99 were females and 51 were males. The left parotid and submaxillary glands were affected in 84 and the right side in 66. The average age of the 100 patients with mixed tumors at operation

TABLE 2
DURATION OF MIXED TUMORS

Less than 1 year	12
1-5 years	25
6-15 years	29
16-26 years	12
Over 26 years	10
Not stated	12

is 45.0 years. The average age of the miscellaneous group is 51 years. The average age of the patients with adenolymphomas is 61.4 years. It has been pointed out that adenolymphoma is more common in men in the fifth and sixth decades of life. Three of our 5 patients were women.

Of 88 patients with benign mixed tumors who gave some statement relative to the onset of disease, the average age was 34.3 years. The average time that elapsed before operation was 10.6 years. Table 2

TABLE 3
AGE AT ONSET COMPARED WITH AGE AT OPERATION

	Appearance	Operation
0-10 years	2	0
11-20 years	17	6
21-30 years	17	11
31-40 years	19	21
41-50 years	18	22
51-60 years	12	21
61-70 years	3	17
71-80 years	0	2

83 per cent had tumors before the age of 50. Only 59 per cent of the group were operated on before the age of 50.

Of the 24 cases of malignant tumor, 23 patients gave statements about the appearance of their disease. The average age at onset was 48 years, the average age at operation was 54.5 years and the average duration of tumor before operation was 6.6 years. If the patients with

lymphoblastomas whose duration was three months five months, eight months and nine years, respectively, were not included the time elapsed before operation for this group would be even higher. The duration of tumor in the malignant group is shown in Table 4.

Table 5 shows this group in age decades at time of onset of tumor and operation for carcinoma.

TABLE 4
DURATION OF MALIGNANT TUMORS

Less than 1 year	10
1-5 years	5
6-15 years	4
16-26 years	4
Not stated	1

Many patients in explaining delay of treatment of these tumors tell us that they thought "if it wasn't bothering them they wouldn't bother it." This adage is frequently abused by both the patient and physician in regard to parotid and submaxillary tumors. The statement has also been made that all mixed tumors of the salivary gland

TABLE 5
AGE AT ONSET COMPARED WITH AGE AT OPERATION

	Tumor Appeared	Operation for Carcinoma
0-10 years	0	0
11-20 years	3	1
21-30 years	1	0
31-40 years	5	4
41-50 years	6	6
51-60 years	3	6
61-70 years	3	3
71-80 years	2	4

are potentially malignant. From the foregoing tables one might also state that they are the most neglected. The patients with carcinoma come to surgery sooner presumably because 35 per cent of the group noted rapid growth upon first appearance. Sudden increase in rate of growth preceding operation was noted in several of the carcinomas and mixed tumors that had been unchanged in size for years.

PRESENTING SYMPTOMATOLOGY

In reviewing records in an effort to evaluate symptomatology, there are no doubt many errors of omission. One may note only the most significant points. Table 6 depicts only generalities in analysis of presenting symptoms.

Excluding the miscellaneous group, 85 histories of patients with

benign tumors gave some information relative to the rate of growth. Of these, 8 patients complained of rapid growth from the time a lump was noted. Of the malignant group, 19 histories furnished statements regarding growth, of these, 7 patients complained of rapid growth from the time a tumor was first noted.

A large number of patients had had previous operative procedures before appearing at the clinic. The best chance of complete removal of a benign or malignant tumor in these areas with the smallest incidence of facial nerve injury and recurrence is at the first operation. Two patients with mixed tumors of the submaxillary gland, 1 patient with mixed tumor of the parotid gland, and 1 with adenolymphoma had incision and drainage before coming to the clinic. Two patients with mixed tumor of the parotid had a tonsillectomy and tooth extraction, respectively, for hyperplastic adenitis, 1 patient with carcinoma of the parotid had a tonsillectomy for hyperplastic adenitis, 5 patients with inflammatory submaxillary glands had one or more incisions and drainage before we saw them and another patient in this group had a tooth extraction for hyperplastic adenitis. Of the total group, 20 patients had had one or more previous excisions of tumor before coming to the clinic.

The symptom of pain was mentioned by one third of the patients with carcinoma but by only 16 per cent of the patients with benign noninflammatory disease. In general the patients with benign processes who had any discomfort had large tumors.

Only 2 of our patients with parotid carcinoma noted paralysis before they discovered a tumor, 1 of these patients presented marked weakness of facial musculature when seen. Another had had facial paralysis on two occasions which lasted weeks and disappeared, he presented only paralysis of the mandibular branch of the seventh cranial nerve when seen. More unusual than this, however, is a patient with adenolymphoma of the parotid gland who came in with paralysis of the mandibular branch of the facial nerve with no history of previous operation. This branch was identified and preserved during operation, and the patient, after two months of continued droop of the angle of the mouth eventually obtained complete restoration of function of this nerve. There were 4 patients with complete facial paralysis tumors and 2 had patients who had limited paralysis only 1 had not had

previous operation. In this series as noted in Table 6 there are several patients who came to the clinic with other complaints but who eventually came to surgery after their tumors were discovered by the examining physician.

Upon examination fixation of the tumor is the most presumptive single physical sign of carcinoma likewise if the tumor is freely movable it suggests benign tumor. Table 7 shows the number of pa-

TABLE 6

PRESENTING SYMPTOMS

	Slow or No Increase in Size	No Change Followed by Rapid Enlargement	Rapid Increase in Size	Previous Operation with Recurrent or Residual Tumor	Pain	Trauma	Presenting Facial Paralysis, No Previous Operation	Presenting Facial Paralysis in Recurrent Cases	Trismus	Came to Clinic for Other Reasons
Mixed tumor of parotid	47	18	7	25	12	4	0	2	4	11
Mixed tumor of submaxillary	7	1	0	1	0	0	0	0	0	2
Malignant tumor of parotid	2	7	9	5	6	2	2	2	2	0
Malignant tumor of submaxillary	0	0	1	0	0	0	0	0	0	0
Adenolymphoma	3	1	1	1	0	0	1	1	0	1
Miscellaneous tumors	11	0	9	7	7	1	0	0	0	3

tients with parotid tumor whose case records contained a statement regarding mobility or fixation

Although fixation or mobility may be of presumptive importance concerning the nature of the tumor, it is more important to note that this tumor as others may present differently regardless of its nature. Consistency and discreteness of the mass likewise are not reliable in estimating the type of tumor

It is interesting from a medicolegal standpoint that 7 patients associated the appearance of their tumors with preceding trauma. Many

TABLE 7
MOBILITY AND FIXATION IN PAROTID TUMOR

Parotid	Fixed	Movable
Benign	8	39
Malignant	10	6

individuals seek an explanation for disease of any type. That they know nothing of fundamentals in speculating as to the *modus operandi* is not a deterring factor.

There is no group of tumors in which some patients are not convinced of the relation of preceding trauma. That such a history is

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RECURRENCES AND FACIAL NERVE INJURY

We are not able from our records to make a study of recurrences or facial nerve injury in relation to the size of the tumor. We cannot accept the conclusions of McFarland that small tumors are more likely to recur after operation than are large tumors. If excision of small tumors is undertaken by those of limited experience and large tumors by the more experienced surgeons, the results might suggest such an observation.

Recurrences following excision for benign tumors of the parotid gland are reported by several groups (Table 8). Surgical excision must be performed technically with two foremost considerations. A liberal margin of normal salivary gland should be removed with the tumor to avoid recurrence. Injury to the facial nerve is to be avoided. If the margin of normal gland removal is too liberal there is increased danger of injury to the facial nerve. One may however avoid facial nerve injury to such an extent that residual tumor remains. Excision of tumor with an adequate margin of adjacent normal salivary gland with preservation of the facial nerve is best accomplished by early isolation and identification of the nerve in all but the most superficially located tumors.

Several other factors influence recurrence of these tumors. Whereas some of the tumors have fairly thick capsules favoring complete removal by close dissection, others have thin capsules which are more likely to be broken during excision. Spilling of the tumor tissue in the wound will favor recurrence. In the operative notes of the records reviewed in this series, tumor spilling is described in 15 cases. Benign mixed tumors are also known occasionally to penetrate their capsules in which case pericapsular dissection is likely to leave tumor cells in the wound. Some writers describe such penetration through the capsule by benign tumors, but such infiltration is more probably confined to cancer. The presence of carcinoma increases the chances of local recurrence. The margin of excision of normal tissue beyond the carcinoma may be the factor which determines whether cure or recurrence results. Operations for recurrent benign tumors of the salivary gland are less likely to result in the successful complete ablation of the tumor and are technically more difficult than operations on patients who have not had previous surgery. Recurrence of carcinoma of a salivary gland inevitably results in failure to cure the disease.

TABLE 8
FREQUENCY OF RECURRENCE

	Per Cent
McFarland	25
Benedict and Meigs	42.5
Wood	45
Stein and Geschickter	20
Ahlborn	20-25 (within 3 years)

Although recurrences of benign tumors of the salivary gland have been reported as late as forty seven years after excision, the majority of these recur within five to seven years. McFarland has given the average time of recurrence as 7.2 years for benign parotid tumors. Of the 21 patients who came to the clinic with recurrent mixed tumor, 3 had their recurrence eleven, eleven and nine years respectively following excision. One had noted a recurrence four years after excision. The remaining 17 had noted their recurrences in less than three years after operation and a few stated they had noted evidence of tumors postoperatively.

Recurrences are much more frequent after excision of carcinoma of the salivary gland. Despite the fact that some of these tumors present as grossly localized superficial tumors, we can find no satisfactory or encouraging report in the literature on results of treatment of this disease. Although our results are poor, we believe we are improving the handling of this problem. We cannot find in the literature a study of parotid carcinoma stating how many of a series were excised on the assumption that they were benign, the operative procedure performed, and the report subsequently revealed a carcinoma. Our charts do not

give such information in this series. We believe many failures in parotid carcinoma surgery are the result of such a sequence of events. It is our belief that when more of these tumors are approached in the manner which is to be discussed, the recurrences and surgical failures will be lessened.

Recurrences are more frequent in certain histologic patterns than in others. To divide the many variations of this malignant tumor into only three groups, as we have in Table 9, does not represent its scope of presentation. Epidermoid cancer and adenocarcinoma give in general a less favorable prognosis than malignant mixed tumors. The variations within these groups necessitate a consideration of the histologic pattern in the prognosis. The management of this problem calls for a surgical approach that will provide removal of wide margins of normal tissue together with the tumor without injuring the seventh cranial nerve. Table 9 presents results of accurate follow up from the

TABLE 9
RECURRENCE

With 5 Years or Longer Follow up	No Recurrence	Subsequent Recurrence	Recurrence Per cent
Benign parotid or submaxillary tumor no previous surgery (13 patients)	11	2	15
Recurrent benign parotid or submaxillary tumor (2 patients)	1	1	50
Parotid or submaxillary carcinoma (10 patients)	1	9	90
Recurrent parotid or submaxillary carcinoma (4 patients)	0	4	100

standpoint of recurrence in only a small group of this series. We are in the process of obtaining accurate follow up data in this entire group for later publication.

We have analyzed our incidence of facial paralysis in those patients having only paralysis of the mandibular branch and those having complete paralysis. The figures shown in Table 10 include all cases of minimal and intentional nerve sacrifice. Our incidence of facial paralysis has been greater in patients with recurrent tumors, benign or malignant,

is more frequent in patients with recurrent tumors, benign or malignant, which case -- Facial paralysis or carcinoma, in 1 if they traverse the tumor bed, we do not hesitate to sacrifice the main trunk of the nerve if we are excising carcinoma through which the main trunk of the nerve runs. In 1 of our 3 cases of benign tumor with complete facial paralysis, we were unable to obtain a specimen taken at previous

operation, at which time a diagnosis of carcinoma had been made. The association of nerve and tumor dictated sacrifice of the nerve. In another, the surgeon was convinced at the operating table that he was dealing with carcinoma. This latter case brings up the situation which in our opinion is the only one warranting cutting into the tumor bed.

TABLE 10

DAMAGE TO FACIAL NERVE BY SURGERY OF THE PAROTID GLAND

	Total Per cent	Benign Per cent	Malignant Per cent
Benedict and Meigs	13.7	7.5	20.0
Stein and Geschickter		10.0	
McFarland	4.4		
Ahlborn	16.9	11.0	36.6
Marshall and Miles	14.5	10.0	50.4

for a biopsy specimen. Routinely we make every effort not to enter the tumor bed. When a decision has to be made whether the main trunk or upper secondary branch has to be sacrificed, a pathologist's opinion of the type of the tumor may give presumptive reason for removal of the nerve. In 3 of the 4 cases of complete paralysis follow-

TABLE 11

FACIAL NERVE INJURY AFTER PAROTID SURGERY IN LAHEY CLINIC

	Mandibular Branch Paralysis		Complete and Cranial Nerve Paralysis	
	Recurrent Tumor	No Previous Surgery	Recurrent Tumor	No Previous Surgery
Mixed tumor	3 of 18 16.6%	4 of 74 5.4%	1 of 18 5.5%	2 of 74 2.7%
Carcinoma	1 of 4 25%	2 of 19 10.5%	1 of 4 25%	3 of 19 15.8%
Adenolymphoma	0	0	0	0

ing surgery for carcinoma the nerve was demonstrated to enter the tumor bed. In cutting the lower and upper branches, one does not hesitate to cut the mandibular branch of the facial nerve for benign disease if

give such information in this series. We believe many failures in parotid carcinoma surgery are the result of such a sequence of events. It is our belief that when more of these tumors are approached in the manner which is to be discussed, the recurrences and surgical failures will be lessened.

Recurrences are more frequent in certain histologic patterns than in others. To divide the many variations of this malignant tumor into only three groups, as we have in Table 9, does not represent its scope

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We have analyzed our incidence of facial paralysis in those patients having only paralysis of the mandibular branch and those having complete paralysis. The figures shown in Table 10 include all cases of minimal and intentional nerve sacrifice. Our incidence of facial paralysis has been greater in patients with recurrent tumors benign or malignant than in those having no previous surgery. Facial paralysis is more frequent following operative procedures for carcinoma in which case secondary branches are readily sacrificed if they traverse the tumor bed, we do not hesitate to sacrifice the main trunk of the nerve if we are excising carcinoma through which the main trunk of the nerve runs. In 1 of our 3 cases of benign tumor with complete facial paralysis, we were unable to obtain a specimen taken at previous

In small, superficial, presumably benign tumors, a vertical incision is made anterior to the tragus of the ear. Upon dividing the skin and subcutaneous tissue, a flap is dissected anteriorly, exposing the tumor. If the tumor is small and protudes from the periphery of the gland, it may be dissected safely from its bed with some adjacent, grossly normal salivary gland. If the tumor projects medially into the deep portion of the gland, if there is question of its benignancy, or if the surgeon is not satisfied with the presenting line of dissection because of inadequate margins or fear of injuring the facial nerve, the incision is enlarged. An enlargement is obtained that we recommend for all large parotid tumors and all that are suspected of cancer. It consists of prolonging the incision inferiorly over the posterior border of the angle of the mandible and anteriorly below the inferior border of the mandible and making another oblique incision posterior to the ear. These two join at a point directly beneath the pinna of the ear. By dissecting the subcutaneous tissue of this obtuse angle with its overlying skin superiorly, the ear is elevated. If there is fixation of the tumor to the overlying skin, the incision may be easily modified also to excise an ellipse of overlying skin with the tumor. A skin flap containing little or no subcutaneous tissue, depending on the presenting problem, is then elevated anteriorly from the surface of the parotid gland and retromandibular area. This may be carried anteriorly well closure. In large is blocked, and edged anteriorly.

In any case upon isolating the nerve, dissection can be carried out anteriorly, preserving the nerve, with the gross tumor mass under vision at all times. As the dissection proceeds the operation may be altered to extensive subtotal parotidectomy or complete ablation of the gland, including the tongue of parotid gland that protrudes retropharyngeally and lies medial to the nerve. Except for this tongue of salivary gland of inconstant size very little of the parotid gland need be traversed to excise the bulk of the gland. The nerve lies on the lateral surface of the masseter muscle after coursing through 2 cm or less of salivary gland. The stimulating electrode used by the neurosurgeon is of great value in identifying branches of the facial nerve and should always be employed.

Of greatest aid in dissecting for the nerve after developing flaps and before locating the nerve as it exits from the stylomastoid foramen is the identification and ligation of the external maxillary artery in

dissection for the nerve and excision of the tumor. The few minutes required for external maxillary ligation is more than compensated for

saying it necessitates opening the tumor widely in the operative wound, perhaps leaving islands of tumor cells remaining, and thus endangering chances of complete excision. Nor should one hesitate to sacrifice any part of the nerve in cases of carcinoma if the nerve definitely traverses the tumor. Our one case of persistent paralysis of the peri orbital muscles but intact mandibular branch of the nerve in a case of mixed tumor with no previous operation is included in the group with complete facial paralysis. Further analysis of facial paralysis in this group is shown in Table 11. In addition to the facial paralysis in our operative series, there were 4 patients with facial nerve paralysis, in 1 complete, who had recurrent parotid tumors. In 2 of these, paralysis occurred following operation for mixed tumor, in 1 there was complete permanent injury of the facial nerve. In 2 cases, paralysis occurred following operation for carcinoma of the parotid, in 1 of which it was complete. Interesting also are the 2 patients with carcinoma and 1 with adenolymphoma who had paralysis of the facial nerve as a part of the onset of the disease and who had not had previous operation.

TREATMENT

Tumors of the parotid and submaxillary areas are primarily surgical problems. The possibility of cancer should always be considered in all tumors of this region. The surgical problem is that of completely excising the neoplasm and avoiding unnecessary injury to the facial nerve. The lack of appreciation of the possibility of cancer and the fear of injury to the facial nerve have contributed to the surgical failures in this problem.

Sistrunk, in 1921, and Adson, in 1923, described methods of surgical approach by identification and preservation of the facial nerve, thus enabling the surgeon to excise tumors of the parotid area more adequately. In each instance they recommended isolation and identification of the mandibular branch of the nerve which is followed back to the main trunk. Despite this approach, Sistrunk had several cases of partial and complete paralysis. We agree with Bailey, of England, and Janes, of Toronto, who advocate isolation of the main trunk of the nerve in all but the most superficial benign parotid tumors. The nerve can with only occasional difficulty be identified as it exits from the stylomastoid foramen. With careful dissection it may be followed forward and the secondary branches preserved. Although the better method of approach is usually the one the surgeon is better acquainted with, it is almost a surgical structure such as the facial nerve part if it is equally accessible accessible in all but the very large tumors in the region between the angle of the mandible and the mastoid process, in those, also, exposure of the main trunk can be accomplished.

excision of adequate margins of adjacent normal tissue can best be accomplished (3) We believe that improvement will result in the percentage of recurrences of benign disease cures for carcinoma and number of facial nerve injuries by the application of these surgical principles

One may find almost any opinion he wishes to accept concerning radiation therapy for benign or malignant disease of the salivary gland That mixed tumor is highly radioresistant is a generally accepted fact No radiologist reports cures in any series of carcinoma of the salivary gland but much is written about regression relief of pain and radiosensitivity in selected cases Carcinoma of the salivary gland in the oral cavity is notoriously more resistant than the epidermoid variety Highly undifferentiated adenocarcinoma is said to be radiosensitive, the remaining types are less sensitive We are unable to evaluate our experience with this agent in the 11 cases in which postoperative therapy was given, 9 patients treated had carcinomas and 2 benign mixed tumors Of the benign tumors, in 1 the capsule contained tumor cells the other was regarded as a highly cellular mixed tumor There was obviously the question of diagnosis

A word of caution is appropriate regarding too vigorous radiation therapy to this region Increased morbidity is reported in the form of ulceration, facial nerve paralysis pain, temporomandibular ankylosis and radionecrosis of the mandible following doses of radiation that are tolerated satisfactorily a few centimeters lower on the neck Undoubtedly, some of this morbidity in reported cases is due to carcinoma in spite of radiation instead of radiation *per se*

CONCLUSIONS

One hundred and fifty cases of tumors in the parotid and submaxillary regions are reviewed as to differential diagnosis, symptomatology, pathology and treatment

Problems of delay in institution of treatment diagnosis and surgical management are presented and emphasized

The incidence in this group of recurrent tumor and facial paralysis following operation is discussed

A surgical approach is discussed which in our opinion will improve the surgical treatment of parotid tumors

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by the maintenance of hemostasis and thereby assistance in following the nerve forward

In approaching the stylomastoid foramen for identification of the facial nerve dissection is made within a few millimeters of the anterior surface of the mastoid process. The nerve lies 1 to 2 cm medial to the lateral surface of the tip of the mastoid. It exits at a point 1 cm superior to the tip. Its axis in the superior-inferior plane may appear inconstant owing to slight variations of position on the table in different patients. When dissecting in this region the tendon of the digastricus, the tip of the mastoid process, the styloid process and the transverse process of the axis are readily identified.

Anesthesia is obtained by intratracheal intubation with an inhalation anesthetic of the surgeon's choice. Intratracheal intubation is of aid not only in maintenance of oxygenation and anesthetic level but it permits proper draping of the field and access of the surgeon and two assistants to the field without interfering with the anesthetist.

If metastatic carcinoma is found in lymph nodes directly below the parotid tumor or elsewhere in the neck radical neck dissection of tissue in continuity with the field of primary disease is done.

A cotton plug in the external auditory canal at the onset of operation aids in avoiding subsequent difficulty of removing dried spilled blood that inevitably finds its way there.

A drain is usually not necessary if a pressure dressing around the entire head is applied with elastoplast. In such application the ear should be padded to avoid pressure chondritis. In extensive subtotal parotidectomy or complete ablation of the gland a Penrose drain left in place for three or four days will provide an exit for secretions and permit better wound healing.

As the result of excellent tissue vitality in this area wound healing usually is good and scars often are scarcely noticeable. This is particularly true of the submandibular portion of the scar which is visible at only a few angles.

If large segments of skin are sacrificed which is necessary only in very large ulcerating or skin-involving tumors, this region does not afford a satisfactory site for primary skin graft. Although fistula has not been a problem in our series, salivary seepage for a few days is not uncommon. This small amount of seepage is minimized by a carefully applied pressure dressing. A small salivary leak beneath a

tures fear of which may result in inadequate excision and lack of respect of which may result in needless injury. A correlation is the principle of exposure of the recurrent laryngeal nerve in thyroid surgery. (2) As a result of the first advantage, excision of parotid neoplasia with adherence to fundamental concepts or specifically

THE MANAGEMENT OF ANESTHESIA FOR SURGERY OF THE NECK

EDWIN R. RUZICKA AND URBAN H. EVERSOLE

The successful management of anesthesia usually requires clear thinking, sound clinical judgment and manual skill on the part of the anesthesiologist. The physiology, pharmacology and proper management of anesthesia may be especially true during surgical procedures on the neck. It has become increasingly clear to the surgeon and patient alike when considering these factors that the first requirement for the successful management of anesthesia is the presence of a skilled anesthesiologist.

THE MAINTENANCE OF A CLEAR AIRWAY

The importance of maintaining a clear airway during the administration and effect of any anesthetic drug producing unconsciousness can not be emphasized too strongly. Elevation of the mandible and tongue by applying pressure with the fingers behind the angles of the jaw may be sufficient; however, the insertion of an oropharyngeal or nasopharyngeal airway may be necessary. A nasotracheal tube or orotracheal tube may be required.

Oral airways and endotracheal tubes may be used on either the conscious or unconscious patient. Unless preliminary topical anesthesia has been done, the unconscious patient must be in the second or third stage of anesthesia to tolerate an artificial airway. The conscious patient should be familiarized with the reasons for the procedure, with the steps involved and with the sensations to be expected when the artificial airway is installed and in place. Then the unhurried anesthetization of the mucous membrane of the mouth, pharynx and when necessary the epiglottis and trachea should be carried out. When nasopharyngeal or nasotracheal tubes are to be used, the nasal mucosa must be anesthetized. There are many anesthetic agents suitable for topical application or spraying. A solution of cocaine 10 per cent is very satisfactory. It provides good local anesthesia and in addition has a tendency to shrink the nasal mucosa.

Anyone entrusted with the anesthetic management of patients should be familiar with the technique of direct laryngoscopy and tracheal intubation. It may be a factor of prime importance in maintaining an adequate airway and is a technique which should be used without hesitation when there is any question of maintaining unobstructed respiratory exchange. Gillespie has prepared an excellent monograph on endotracheal anesthesia.¹ This work will not be summarized, but several factors must be brought to mind.

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Anyone entrusted with the anesthetic management of patients should be familiar with the technique of direct laryngoscopy and tracheal intubation. It may be a factor of prime importance in maintaining an adequate airway and is a technique which should be used without hesitation when there is any question of maintaining unobstructed respiratory exchange. Gillespie has prepared an excellent monograph on endotracheal anesthesia.³ This work will not be summarized, but several factors must be brought to mind.

Endotracheal tubes may be classified as nasotracheal or orotracheal. Nasotracheal tubes are probably indicated particularly when the demands of the surgical procedure forbid the use of an orotracheal tube. Nasotracheal intubation may also be attempted when it is anticipated that laryngoscopy would be very difficult or when attempts at laryngoscopy have proved unsuccessful. The routine use of blind methods of endotracheal intubation is inadvisable. Nasal vessels are very superficial and lie on prominent bony or cartilaginous landmarks. The passage of a nasal tube is always attended by the possible complication of profuse nasal hemorrhage. Trauma to the structures in the pharynx and larynx is much more likely with blind methods of tracheal intubation. Blind methods exclude a valuable diagnostic procedure. It is not usual but is certainly not rare, to find unsuspected disease in the pharynx and larynx when these structures are exposed under the direct light of the laryngoscope. The patient should not be deprived of the valuable diagnostic feature of laryngoscopy for the sake of expediency and the saving of a few minutes.

The flexible metal tube described by Woodbridge is very satisfactory when an orotracheal tube is used.⁶ It is safe to use and will withstand great pressure before it will collapse. When the larynx is difficult to expose and the tracheal opening is visualized only in part this tube may be used to good advantage. The stilet may be withdrawn about an inch. This leaves the end of the tube very flexible. It may then be possible to slide the tube into the trachea much after the fashion of a sled runner. The tube should not be inserted into the trachea against resistance. This is of course a rule for any type of endotracheal tube. Other types of metal endotracheal tubes include the original Flagg and the Coryllos-McKesson tube which is similar to the other metal tubes but has also a lamp carrier which provides illumination like a bronchoscope. Metal tubes have the advantage of not being subject to obstruction by kinking. They also have thin walls and do not so restrict the size of the glottic openings. Finally they are very durable and may be sterilized by boiling. They must be covered with Penrose rubber tubing to prevent trauma to the trachea by the metal coils and to make the tube airtight. There is a variety of tubes made of semirigid materials. An example is Hargrave's tube which is made of coiled silver wire covered with flexible silk elastic. A popular endotracheal tube is the curved rubber tube commonly known as the Magill tube. The Magill tube is most often used as a nasotracheal tube although it may be used as an orotracheal tube when the occasion demands.

An important addition to any type of endotracheal tube is the inflatable rubber cuff first described by Guedel and Waters.⁴ The cuff need not be used at all times but may be put on the tube when necessary.

The cuff can be inflated with air after the tube is in place and

serves the dual purpose of maintaining an airtight fit for the administration of the anesthetic agent as well as preventing the aspiration of foreign material into the trachea

A TECHNIC FOR THE INTRAVENOUS ADMINISTRATION OF FLUIDS

In many of the surgical procedures on the neck fluids including blood transfusion must be given. It is obvious that when the surgeon and his assistants, the anesthesiologist and his equipment and the nurse and the instruments are gathered around the head and neck of the patient there is little room for proper administration of intravenous fluids through a vein in the arm. It is equally satisfactory to administer the fluids by means of a vein in the foot or ankle. There has been no increase in the occurrence of phlebitis as a result of this procedure.

POSTOPERATIVE POSITION OF THE PATIENT

The position of the unconscious patient without tracheotomy is of great assistance in maintaining a clear airway. The patient is placed on his side with the side operated on usually in the uppermost position. The knees are flexed with the upper knee in slightly more flexion than the lower. A pillow is placed at the patient's back. The upper shoulder is drawn back so that it will not fall across the neck or face of the patient. The elbows are flexed and the hands are placed below the level of the clavicle. The hands should not be placed in front of the face. The patient in this position is less likely to become obstructed or to aspirate blood, vomitus or mucus. There would seem to be no excuse for placing an unconscious patient in the sitting up position.

The tracheotomized patient may lie on his back. A means of suction must be kept constantly at hand and in good repair. Although constant supervision is necessary, the mechanical airway is assured so long as fluids do not collect in the tube.

SURGICAL PROCEDURES AND INDICATED METHODS OF ANESTHESIA

1. Surgery of the Thyroid Gland.—General anesthesia is the rule for all thyroid surgery. No attempt should be made to trick the patient concerning his operation. Patients with disease of the thyroid gland are usually reconciled to surgery. Anesthesia is the unknown quantity. A preoperative visit by the anesthesiologist with a frank discussion of the anesthetic agent and method to be used is greatly appreciated and promotes a well balanced cooperative patient.

A detailed account of the management of patients needing thyroid surgery is to be published.¹ Suffice it here to say that cyclopropane is the anesthetic agent offering the most advantage as regards a pleasant rapid induction and a high degree of potency. Cyclopropane however is well known to increase the irritability of heart muscle and to be a factor in the production of cardiac arrhythmias. Therefore it should probably not be used on patients with thyrotoxicosis since

this condition is known to produce hyperirritability of the heart. The use of heavier preoperative medication, induction of anesthesia with ethylene or nitrous oxide with the addition of ether for the maintenance of the anesthetic level desired are employed in these cases. It is a clinical impression that the cardiac hyperirritability which is a part of thyrotoxicosis is well controlled by thiouracil therapy and usually offers no problem to the anesthesiologist.

The endotracheal tube should be used in thyroid surgery when there is a deviated or compressed trachea, cancer of the thyroid, intrathoracic extension of the tumor, paralysis of either or both vocal cords and for all secondary operations. Should ordinary methods of maintaining an airway during the course of anesthesia prove inadequate, there should be no hesitancy about introducing an endotracheal tube.

When there is roentgenologic or clinical evidence of marked distortion of the pharynx, larynx or trachea caused by enlargement of the thyroid gland or there is persistent preoperative stridor, the endotracheal tube should be placed in position under topical anesthesia before a general anesthetic is administered. This is not difficult or trying to the patient. It requires patience, skill and an explanation to the patient of the sensations to be experienced. The patient must be told that when the tube is in place he should not try to talk.

The advent of the new antithyroid drugs such as thiouracil and similar drugs, has practically eliminated the two-stage operation for thyroidectomy. The anesthesiologist should be familiar, however, with the principles to consider in the thyrotoxic patient. These are the oxygen consumption above the usual basic requirements, which are considered to be 250 cc. of oxygen per minute, elevation of the pulse rate to 120 or above, and elevation of the pulse pressure. These factors must all be weighed when a decision as to whether or not to complete the thyroidectomy or to do a two stage operation must be made.

2. Surgery for Esophageal Diverticulum—Some of these patients may be poor operative risks as a result of malnourishment, avitaminosis and varying degrees of lung disease caused by aspiration of regurgitated contents from the diverticulum. All possible medical means indicated should be taken to get these patients in the best possible condition for operation. No oral preoperative medication should be administered. In most cases this medication enters the diverticulum and exerts no clinical effect. The barbiturates when ordered preoperatively should be dissolved in sterile water and given by hypodermic syringe if it is being used.

The value of this precaution becomes instantly evident when a diverticulum suddenly empties its contents into the esophagus and pharynx. This foreign material may be readily aspirated into the trachea. It is prevented from being aspirated into the lungs alongside of the tube because of the block provided by the inflated rubber cuff.

Recently, a man 40 years of age was undergoing the first stage removal of an esophageal diverticulum. The anesthesia was uneventful and an orotracheal tube without an inflatable cuff was in place. Suddenly it was noted that efforts at inspiration were exaggerated and there was inefficient respiratory exchange. The flexible metal orotracheal tube was removed, found to be in perfect condition and reinserted without benefit to the patient. This was done under direct vision while the operative procedure was continued. The surgeon was then requested to stop the operation and a bronchoscopy was done using a set kept sterile for such emergencies. A large plug of mucus of solid consistency was found obstructing the left main bronchus and part of the right main bronchus. This was removed, the orotracheal tube was reinserted with an inflatable rubber cuff attached at this time and the operation was continued without further complication.

3 Surgery of Pharynx and Larynx—The controversy whether or not it is better to do tonsillectomy with the patient in the sitting up or lying down position will not be entered here. Indeed position is probably not an important factor in the production of chest complications. Properly conducted anesthesia, careful hemostasis and the use of suction during operation are the most important considerations. A wise precaution at the close of the surgical procedure is the insertion of a catheter attached to suction into the trachea. After operation on the return to bed and in bed these patients should lie on their side in the manner previously described for the maintenance of a free airway.

The management of anesthesia for laryngoscopy, for bronchoscopy and for esophagoscopy is concerned with a choice between two methods. The intravenous method involves the use of pentothal and curare. The inhalation method involves the use of ordinary inhalation anesthetic agents for induction and maintenance of anesthesia under ether by pharyngeal insufflation. An important step in the preparation for either method is the careful use of topical anesthesia by spray on the tongue, pharynx, larynx, epiglottis and trachea before anesthesia is begun.

Pentothal and curare probably should not be used for the aged patient, the debilitated patient, those having demonstrable pathologic change in the lung with or without excessive bronchial secretions, and those with severe anemia. When pentothal and curare are used, the curare should be administered first and the pentothal not added until the effect of the curare is noted. An initial dose of 40 to 60 units of curare is usually satisfactory. The patient should then be carefully watched for drooping of the eyelids or difficulty in raising the arms and diplopia. If the patient is given the curare without the pentothal, the curare should be given in very small doses but in very small doses the complete

relaxation produced by curare has developed. This is done in order to prevent the distressing subjective symptoms noted when curare is given to a conscious patient.

Either method of anesthesia offers easy adaptability for moving the patient from the operating room to the x ray room. Ether anesthesia may be continued by the open drop technic and, of course, the pentothal may be continued intravenously. Other considerations being equal it may be considered safer to use pentothal when the patient is to be taken to the x ray room.

Laryngectomy presents a problem in maintenance of airway. When the tracheotomy has been previously established it is advantageous

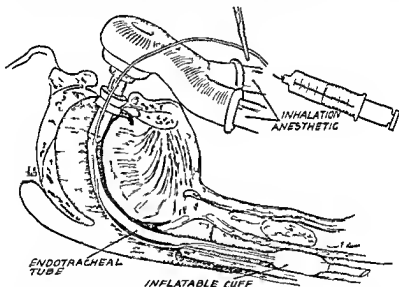


Fig. 200—Anesthesia for laryngectomy. Endotracheal tube in place prior to opening of trachea. Note inflated cuff around tube.

to remove the tracheotomy tube under pentothal anesthesia. Tracheotomized patients are very conscious of their airway and painfully sensitive to the ease with which it may become blocked. The tracheotomy opening and trachea should be anesthetized with a suitable topical anesthetic agent following the removal of the tube. A flexible metal endotracheal tube with an inflatable rubber cuff may then be placed in the trachea through the tracheotomy opening. When the cuff is inflated, a very satisfactory airway is assured even though the flexible metal tube is freely movable in any direction. The endotracheal tube may then be connected to the anesthesia machine and anesthesia continued in the manner desired.

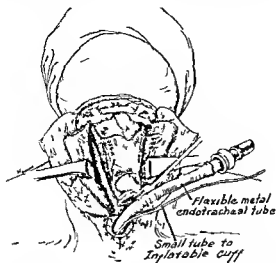


Fig 201—Anesthesia for laryngectomy Endotracheal tube with inflatable cuff inserted through tracheostomy

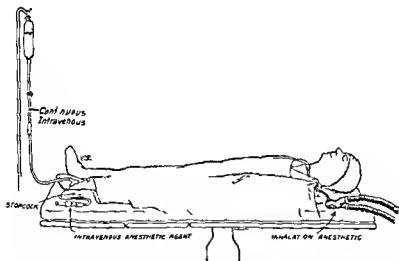


Fig 202—Anesthesia for laryngectomy Note endotracheal tube connected outside operative field for administration of oxygen and inhalation anesthetic agents Continuous intravenous drip in an ankle vein permits administration of an intravenous anesthetic agent

If the electrosurgical unit is being used, it is probably wise not to use an inflammable anesthetic agent. An excellent combination is pentothal intravenously supplemented with nitrous oxide and oxygen

When the tracheotomy has not been previously established, the orotracheal tube is used in the usual manner until the larynx is excised. The tube must then be removed and inserted into the tracheotomy opening. This maneuver may require the cooperation of the surgeon in that it may be desirable for him to place the tube into the tracheotomy opening (Figs 200, 201 and 202).

4. Ligation of Internal Carotid Artery.—Pentothal is adequate for the preliminary roentgenologic studies to determine the presence of aneurysm of cerebral vessels. It is usually necessary when this is done to have two people attending the patient. The administration of pentothal must be done in such a manner as to provide clear access for the taking of roentgenograms of the head and neck and also enable the surgeon to work in the neck. An assistant administers the pentothal and the anesthesiologist takes care to maintain a clear airway. After these preliminary studies, ligation of the internal carotid artery should not be carried out until the patient is conscious. It is necessary to have the patient awake when the internal carotid artery is ligated in order to detect immediately any paralysis which may occur if collateral circulation proves to be inadequate.

5. Thyroglossal Duct Cyst Surgery.—Anesthesia in these cases is

mask in place. Under these conditions it is necessary to pack the pharynx carefully with moist gauze and to tape the endotracheal tube securely in place. Then by means of an adapter, the endotracheal tube may be connected to the anesthesia machine and anesthesia continued under conditions which allow the anesthesiologist to maintain complete control of the patient.

THE MANAGEMENT OF COMPLICATIONS OCCURRING UNDER ANESTHESIA

1. Respiratory Obstruction.—When, as a result of operative manipulation, respiratory obstruction occurs which cannot be relieved by the ordinary methods, an endotracheal tube should be introduced immediately, even though it may be necessary to halt the operation. Again, methods of intubation under direct vision are preferable. Respiratory obstruction plus a nasal hemorrhage caused by passage of a nasal airway greatly increases the risk of the entire procedure.

2. Nasal Hemorrhage.—The use of nasal airways or Magill endotracheal tubes may be attended by a complication which is always distressing and may be serious. This is nasal hemorrhage. When it occurs, the patient should be placed in the head down position, the anesthetic discontinued, the airway removed if it should become plugged with blood, and a catheter connected to suction used to clear the pharynx and larynx and if necessary, the trachea. The

hemorrhage is usually of short duration when this procedure is followed. It is rarely necessary to adopt radical means to stop the hemorrhage. If necessary, packs may be applied into the nostril which is bleeding.

When the bleeding point is in the posterior part of the nasal fossa, a posterior nasal pack may be necessary. A urethral catheter may be passed through the nose into the pharynx and a pack tied to the catheter with a fairly long string. The catheter may then be withdrawn pulling the pack into the posterior nasal passage. It is obviously important to prevent the aspiration of blood into the trachea with the subsequent danger of atelectasis, pneumonia or lung abscess.

It may be well to mention here that the administration of anesthetic agents which produce unconsciousness should probably not be done

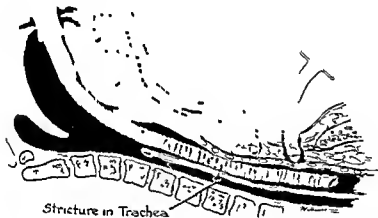


Fig 203.—Anesthesia for tracheotomy. Position of endotracheal tube before opening is made into trachea.

unless there is at hand a satisfactory and instantly available source of suction. Constant disregard of this precaution may result in unnecessary complications or even fatalities.

3. Paralysis of the Vocal Cords.—This infrequent complication usually occurs after thyroid surgery. It is usually a bilateral paralysis, caused probably by pressure on the recurrent laryngeal nerves by edema of the thyroid remnants. When the edema subsides, vocal cord paralysis disappears. Until that time the patient must have a tracheotomy.

The management of a patient with vocal cord paralysis postoperatively requires tact, consideration and quick action at times. The anesthesiologist should not wait in the operating room but should go to the patient's room prepared to do endotracheal intubation at any moment.

These patients are acutely aware of their failing airway and are nervous and firmly handled under topical.

produced by general anesthesia may cause sudden complete respiratory obstruction when skeletal muscles are still taut. Intubation will then be difficult and accompanied by much trauma. A surgeon ready to do tracheotomy immediately should be standing by during all preliminary maneuvers.

Once the endotracheal tube is in place, the tracheotomy may proceed without danger. When the trachea is opened, the endotracheal

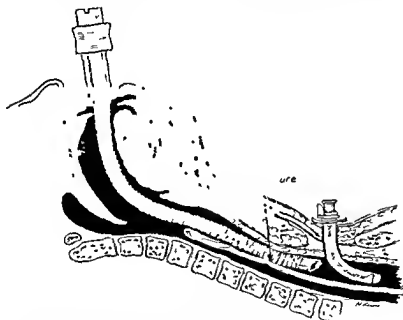


Fig. 204—Anesthesia for tracheotomy. Position of endotracheal tube after incision of tracheotomy tube. With obturator in place breathing continues through endotracheal tube for maintenance of anesthesia.

tube should be inserted in place so around the tracheotomy tube may be unhurriedly completed.

4. Accidental Opening of the Trachea. The anesthesiologist should be informed as soon as it occurs or

suspected Squeezing the breathing bag on the anesthetic machine will produce positive pressure in the trachea and prevent aspiration of blood through the hole in the trachea. This maneuver may also be a diagnostic aid. When a hole in the trachea is suspected but not easily found, positive pressure may cause bubbles to appear or may cause a noise to be heard as a result of anesthetic mixture under pressure passing through the hole at the site of injury. Positive pressure should be maintained until the opening is closed.

5. Carotid Sinus Reaction.—This is an infrequent but very alarming complication. The symptoms are a sudden disappearance of or a severe drop in blood pressure, absence of arterial pulsations and a

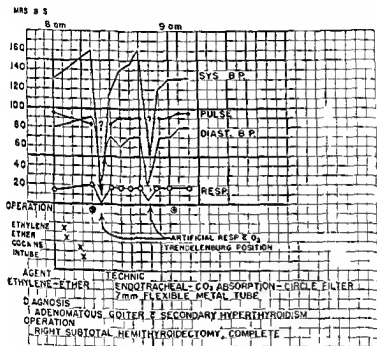


Fig. 203—Anesthetic chart of patient who developed a carotid sinus syndrome during the course of thyroidectomy

change in respiratory rate and rhythm. The respiratory rate may be markedly decreased or there may be no breathing. Treatment must

carotid sinus. The recovery is usually as sudden and dramatic as the

appearance of this untoward reaction. After complete recovery there is *no* contraindication to the continuation of the operative procedure (Fig. 205).

6 Exophthalmos—Serious corneal damage may result from anesthesia and surgery in patients with severe exophthalmos if adequate precautions are not taken to protect the eyes. Anesthesia can be induced with a minimum amount of pentothal necessary to instill an inert protective ointment into the eyes and to apply a protective covering. Sheet gutta percha, which can be molded into position with a sponge moistened with hot water, is very satisfactory for this pur-



Fig. 206—Sheet gutta percha molded into place over the eyes of a patient with severe exophthalmos for protection during the course of operation. Boric ointment should be placed in the eyes prior to application of gutta percha.

pose. Anesthesia may then be continued under the desired technique, with no danger of injuring the eyes (Fig. 206).

SUMMARY

Anesthesia for surgery of the neck requires planning and attention to detail. The anesthesiologist should be familiar with the surgical procedure to be done and with the possible complications which may arise. He must also have all mechanical aids for the maintenance of an airway ready for use and be familiar with the indications and contraindications for each method. It is important to realize that the patient's airway must be maintained for him until he regains consciousness. Position is a very important factor to be considered in the unconscious patient.

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PITUITARY TUMOR

LEWIS M. HURXTHAL

THE early diagnosis of pituitary tumors is important chiefly because they often tend to increase in size, to threaten eyesight and to cause marked endocrine deficiencies. The presence of a pituitary tumor may not be suspected until these changes have taken place, at which time hope of reversing the damage created is lessened considerably. The early signs and symptoms by which a pituitary tumor may be suspected and discovered will be emphasized herein.

For clinical purposes, there are two types of intrasellar tumors which may cause pressure effects. One is the hypersecretory tumor which results in either gigantism before puberty, acromegaly or gigantism during puberty or acromegaly after puberty. This tumor, often composed chiefly of eosinophilic cells, may produce its hormonal effects without local pressure or enlargement of the sella turcica.

The other type is the chromophobe tumor, whose cells are non-secretory, which produces its changes by pressure on normal functioning pituitary cells, thus depriving the body of one or more of the hormones that maintain the secretory capacity of other endocrine glands. The degree of pituitary deficiency varies so that at times it is barely detectable on physical examination or, on the other hand, it may be so severe that a condition approaching complete lack of pituitary hormones results, such as is found in Simmonds disease. An expanding tumor before puberty causes retardation of growth and of sexual development.

In acromegaly or gigantism all hormonal factors of the pituitary may not be increased or decreased simultaneously. The amenorrhea of acromegals is in some cases at least, probably the result of pressure of the tumor rather than an excess of gonadotropic hormones. The same is true in gigantism where sexual development may be almost completely inhibited in spite of great somatic and linear growth.

While it is true that in chromophobe tumors there is no evidence of excessive hormonal activity, there are frequently signs or symptoms which indicate a predominant deficiency of one. For example, the clinical symptoms of pituitary adrenal insufficiency (without pigmentation) may be present and respond to the same treatment as given in Addison's disease. At other times lack of gonadotropic factors may be predominant or, more rarely, the thyrotropic hormone may be relatively more deficient, producing an apparent clinical myxedema.

It is generally taught that an acidophilic tumor will be found in acromegaly or gigantism, but actually mixed or nondescript tumors may be present, thus disappointing the clinician when the pathologist

report is returned. There may be several reasons for this, such as the duration or effect of pressure of the expanding tumor upon itself, the degree of activity, previous roentgen treatment and possibly hormonal treatment such as estrogens or androgens. Even desiccated thyroid may well change the staining reactions of the pituitary cells. Furthermore, the fixation of pituitary tissue in Zenker's solution with acetic acid will prevent recognition of eosinophilia.

A decrease in visual acuity and/or defects in the visual fields are always suggestive of pressure on the optic chiasm. Bilateral or unilateral hemianopsia is generally good evidence of a pituitary tumor—at least it must be excluded. Pallor or actual atrophy of the optic nerve is the rule, when hemianopsia is present, although in some instances choked disks may be found. There is no characteristic headache due to pituitary tumor other than its persistency, thus being unlike the periodic headache of migraine.

It is not proposed here to describe in detail the secondary effects of excess or decreased pituitary hormones, but there are a few signs or symptoms of hormonal change which call for investigation as to the presence or absence of pituitary tumor. Amenorrhea, especially of six months duration or more is an indication for roentgenograms of the skull. All cases of hyperthyroidism in which there is presumptive evidence of acromegaly warrant this investigation. In addition, cases of spontaneous myxedema should also have skull roentgenograms as well as cases of adrenal insufficiency without the usual mucous membrane pigmentation. Hypoglycemic attacks are infrequent in pituitary chromophobe tumor but may occur, thus skull roentgenograms should be considered in cases of hyperinsulinism. Microcytic or normocytic anemia which is unexplained and which fails to respond to iron should raise the question of chromophobe tumor, especially when accompanied by loss of libido in males. Such is usual when chromophobe tumors are present and may be one of the first symptoms noted. These are only some of the signs or symptoms which should be noted.

his name has been

,ed retarded sexual

ds pituitary dwarf

ism due to a suprasellar cyst. Many fat, pubescent children are erroneously diagnosed Frohlich's syndrome. Pubescent obesity when accompanied by a normal height for age even with hypogonadism has been shown not to be a panhypopituitarism, but may represent a selective deficiency of the interstitial cell stimulating hormone (LH), since the titer of urinary follicular stimulating hormone (testicular tubular sustaining hormone) is not decreased. The exception to this statement is to be found in those cases which show soft, formless testes or no testes at all thus constituting a primary gonadal deficiency.

Pituitary dwarfism need not be accompanied by obesity, as indeed Frohlich's case as originally reported was not so afflicted. When pressure on or invasion of the hypothalamic region occurs in these cases marked obesity is usually present, however, as well as evidence of hypophyseal insufficiency. There is, of course, the feminine body contour in young males, but this is true of all prepubescent and pubescent children who have any tendency to obesity. In males such can be considered more indicative of absent or retarded testicular hormone than of the direct effect of pituitary insufficiency.

Suprasellar tumors or cysts (craniopharyngiomas) are frequently found in the pituitary dwarf. Enlargement of the sella turcica may or may not be present. Pituitary disorders without apparent enlargement of the sella turcica raise the question of determining what constitutes enlargement of the latter.

The sella turcica may be enlarged from increased intracranial pressure such as accompanies hydrocephalus. Enlargement of the sella turcica may also accompany suprasellar tumor without actual invasion, probably because of increased intracranial pressure. There are also indirect causes of enlargement of the hypophysis which in turn cause a relative enlargement of the sella.

Primary thyroid deficiency in infancy, which includes congenital or endemic goiter with cretinism or congenital athyreosis, is frequently the cause of some sellar enlargement. It is doubtful that primary myxedema beginning after 18 years of age causes enlargement of the sella, possibly because greater pressure is needed to expand the bony structures at this age. Profound changes in the hypophysis follow castration and some enlargement of the hypophysis has been reported by the older pathologists in eunuchs castrated early in life. Opportunities for such observations are comparatively rare nowadays. It is not the rule to discover enlargement of the sella in males castrated by disease in childhood. A possible explanation of this may lie in the fact that the gonads are relatively inactive before puberty in contrast to the thyroid gland, therefore no such compensatory change takes place at a time when the sellar bones are more pliable. We have recently seen enlargement of the sella in two women past 40 years of age on whom panhysterectomy and bilateral salpingo-oophorectomy was performed before the age of 20. Menopausal symptoms were still present and excess urinary gonadotropins were found making it unlikely that a real tumor was present. Such enlargement of the sella turcica in castrated women appears to be unusual.

The size and weight of the pituitary gland increases with age up to about 25 years, after which time it remains stationary in size until the sixth decade when it becomes slightly smaller. As a rule, the hypophysis is larger in the female than in the male. No increase in weight of the hypophysis, however, has been recorded in women past the natural menopause, which is contrary to expectations. At term

pregnant women may have an increased hypophyseal weight, amounting to double the usual weight. It has also been shown that there is some relationship between the average height of individuals and the average weight or size of the pituitary. With the exception of the increase in size during the growth period it is doubtful if the other variations have any clinical or radiologic importance.

The size of the sella is usually determined by the anterior posterior diameter and the depth. Many such measurements have been made and reported in medical literature. These studies show an average increase from birth to adulthood. We have been interested in other measurements, particularly the area of the lateral contour of the sella as traced on semitransparent ruled millimeter paper.* Our preliminary observations lead us to believe the method has merit especially in comparing the size of the sella from time to time in an individual case. The average adult area as determined by the above method is from 80 to 100 square millimeters. Variations are considerable but average estimations of areas appear significant, as for example, in cretinism in which the majority of areas measure well above the normal range. We have also found that in pituitary dwarfs not due to tumor the area is far below normal averages even when height age is used for comparison instead of chronological age. Furthermore in some cases of acromegaly in which the size of the sella appeared to be normal by the usual measurements the lateral contour area measured in square millimeters was distinctly above average.

A study of a series of cases in which an enlarged area of the lateral contour of the sella was found has been undertaken. A larger number of cases showing an enlarged sella will undoubtedly be found by this method in comparison to the usual method of measuring diameters but we are not as yet able to evaluate these findings. It is possible that in this way pituitary tumors may be uncovered earlier. The lateral contour area method is not new, having been introduced by Haast† in 1925. We believed it deserved reinvestigation inasmuch as the early studies were done without the aid of stereoscopy or use of the Bucky diaphragm.

TREATMENT OF PITUITARY TUMOR

There are certain immediate indications for treatment of pituitary tumor, the foremost of which is visual change. Roentgen therapy is the preferred treatment in the earlier periods when visual loss is not too great. Surgical removal may be necessary in a few cases rather than risk the delay of benefit from x ray treatment. This is especially true when there is evidence of increased intracranial pressure or extension of the tumor as shown by neurologic changes or air studies.

* To be published.

† Haast, L. Erfahrungen auf dem Gebiete der radiologischen Selladiagnostik. Fortschr. d. Geb. der Roentgen Strahlen, 33: 419-422 (Apr.), 469-494 (June) 1925.

Chromophile as well as chromophobe tumors will often react to

ment takes place or vision does not become worse. Radiation therapy is given in courses of six to eight treatments of 300 r, one each day, followed by a rest period. Further courses should be carried out if visual acuity is determined to be poor. Treatment depends on results obtained, and if satisfactory, no more need be given in the immediate future. A total of 7,200 r given within the period of a year is considered a safe amount of radiation. Immediate postoperative radiation is customary in chromophile and chromophobe tumors, or in other tumors which are considered malignant or radiosensitive.

Certain secondary hormonal changes in acromegaly may subside, such as decrease in size of the tongue and some regression of soft tissue changes. Menstrual periods may return and headaches may disappear. The latter is difficult to relieve permanently in acromegalics—even surgery holds out no definite promise of relief of such in this

be the result of hypersecretion

terminated by air studies or surgical exploration

PROGNOSIS

Malignancy is rare in pituitary tumors. Recurrence of benign tumors, however, is not uncommon, due no doubt to technical difficulties in complete extirpation. All types i.e. chromophobe, chromophile, mixed chromophobe and chromophile, and craniopharyngiomas may recur and, in rare instances, rather rapidly.

Prognosis is dependent on many factors which will not be discussed here. Initial successful therapy, be it the result of surgery or irradiation, is not to be considered the final cure. Indeed, it may be only a fortunate and early result in a long and unpredictable battle against the recurrence of tumor, the loss of vision and the profound endocrine deficiencies which may be present or follow. For these reasons, periodic examinations are essential in an attempt to forestall such complications.

EXTRAMEDULLARY SPINAL CORD TUMORS

GILBERT HORRAX

SPINAL cord tumors, or more strictly speaking, tumors within the spinal canal, while by no means as frequent as intracranial tumors, nevertheless represent a sizable group of patients who eventually come under the care of a neurosurgeon. The word eventually is used advisedly, because these patients, as well as many of the patients harboring brain tumors are at first thought to have some other condition than the one which is present, and for this reason not infrequently have been subjected to measures which though well intended, have been incapable of giving them relief. This is not to say that every patient who complains of pain in the arm, the chest or the leg will be found later to have a tumor of the spinal cord any more than every patient who complains of noises and deafness in one ear will turn out to have an acoustic neuroma. On the other hand, pain in one form or another, especially the type of pain which follows the course of a spinal nerve root, is one of the most frequent and important subjective complaints of patients who have tumors of the cord, and when this form of pain is present, careful questioning in taking the patient's history may well elicit other symptoms which would lead one to suspect a spinal origin for the pain rather than some local difficulty or, on the contrary, a condition quite unconnected with the spine. Other symptoms suggestive of a spinal lesion consist in subjective numbness or tingling in the area where pain is felt, especially if this is in the arm or the leg, increasing weakness of one or both arms or gradually increasing weakness of the legs, stiffness in the extremities and sometimes bladder and bowel difficulties which have appeared without any local evidence of trouble with those organs.

In the later stages of spinal cord compression the diagnosis of a tumor as a rule presents no great difficulty. At that stage the subjective complaints of pain and numbness are outspoken, weakness or paralysis below the seat of the lesion is evident, and the patient has a definite level below which many or all forms of sensation are impaired or completely lost. At this stage, likewise, the bladder and bowel function as a rule is greatly interfered with, and indeed the patient may be nearly bedridden. It is, however, to prevent the development of these serious compression symptoms that diagnostic measures should be undertaken to decide about the question of an operable spinal cord condition as soon as any reasonable evidence is at hand to suggest a spinal origin for the symptoms mentioned.

The diagnostic measures indicated consist in a careful detailed history, a neurologic examination, roentgenograms of the spine at the

suspicious level, together with the usual blood and urine laboratory data. In addition to these measures, a lumbar puncture to ascertain particularly the spinal fluid dynamics and the total protein content of the fluid is most important. If the level of the cord lesion cannot be determined by the neurologic studies, some form of contrast medium should be used for this purpose. Lipiodol or pantopaque is the most satisfactory of these media, but if a complete fluid block is present, oxygen or air injected in the lumbar region at the time of the spinal

In a general way, spinal cord tumors may be divided into four main categories (1) the benign, extramedullary growths (neurofibromas and meningiomas), (2) the intramedullary tumors (chiefly ependymomas and various types of glioma), (3) extradural and (4) metastatic growths.

This paper is concerned only with the extramedullary spinal cord tumors. They should be considered individually according to the region of the cord in which they occur, namely cervical, thoracic or lumbar, as their symptomatology is fairly consistent and significant for the region involved.

Since November 1, 1932, when the neurosurgical service was established at the Lahey Clinic, there have been 141 spinal cord tumors verified at operation or at autopsy. Of this number, 53 or 37.5 per cent have been benign, extramedullary growths, either neurofibromas or meningiomas. From this group examples have been selected at random to illustrate the symptomatology seen at various levels of the spinal cord.

1 Cervical Region

One of the early complaints of patients with tumors in this region is that of pain in the neck, shoulder, arm or hand, together with paresthesias of the arm or hand. These pains are often diagnosed as due to a bursitis or neuritis and the patients are given local treatment for such a condition. Later the pain may involve the opposite side as well and there may be awkwardness or weakness of one hand or arm. Later still symptoms of cord compression are noticed, usually an increasing weakness or stiffness of the legs, with dragging of one leg or heaviness of the legs in walking and subsequently loss of sensation in the lower body and limbs, difficulty in voiding and increasing constipation.

Two fairly characteristic examples of extramedullary cervical tumors may be cited.

CASE 1—K M, a woman 52 years of age, was referred by Dr J M Murphy of Brockton, Massachusetts, on June 9, 1941. The family and past histories were irrelevant. Her chief complaints were

- 1
- 2
- 3
- 4
- 5 "Prickling in the left hand for two months"

Present illness For two years the patient had had a throbbing pain in the left shoulder region, brought on especially by motion. This pain had been relieved

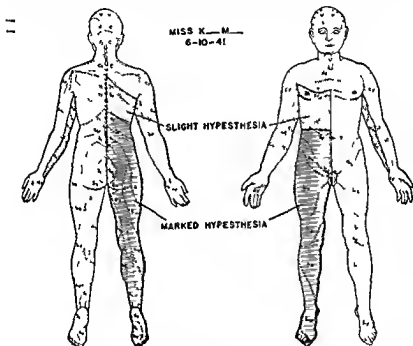


Fig 207—Case 1 Chart showing loss of sensation to light touch, pain and temperature

to some extent by medication until five months before her admission to the hospital at which time pain appeared in the right shoulder following a severe cold. Her teeth were removed without relief of the pain. Roentgenograms of the shoulders were negative but baking and massage gave some relief. Two months before admission she began to have a burning sensation in the right leg, and about the same time she noted a prickling sensation in the left hand. The left hand and arm gradually became weak, and during the month before admission the right hand had become "prickly." Coughing caused extreme pain in both of her shoulders. She had been unable to work for two weeks because of the clumsiness and weakness of the left hand and arm.

Neurologic examination disclosed marked weakness and atrophy of the muscles

of the left hand and forearm together with weakness of the left leg. The left leg was likewise clumsy and ataxic. There was loss of sensation to all modalities over the right side of the body up to the fourth thoracic level, and the first thoracic dermatome on the left also showed loss of sensation (Fig 207). On one occasion the deep reflexes at both elbows were absent but subsequent to a lumbar puncture they became hyperactive. The knee and ankle jerks were likewise hyperactive with a questionable Babinski on the left. Lumbar puncture showed no block but the fluid had a total protein of 156 mg per cent. A lipiodol injection indicated the lower limit of a lesion at the level of the seventh cervical vertebra (Fig 208).



Fig 208—Case 1 Roentgenogram of spine after injection of lipiodols. Filling defect demonstrating lower border of tumor at the level of the seventh cervical vertebra (arrow).

Operation. On June 13, 1941, a laminectomy of the fourth to the seventh cervical vertebrae was performed. An encapsulated tumor was disclosed on the left side and almost wholly underneath the cord at the sixth cervical segment (Fig 209). The cord was compressed to about half its normal size. The size of the tumor was first reduced by removing some of its contents after incising the capsule and then the entire growth could be carefully delivered and excised. The tumor was attached to the sixth cervical nerve root, and this root was therefore divided.

The pathologic diagnosis of the growth was a perineural fibroma.

The patient made an uneventful convalescence. She reported in January 1942 that she had returned to her usual work but that her left hand was still slightly

weak. In December 1942 (one and one half years postoperatively) she returned for a check up examination. At that time the left hand was very slightly weak. No sensory disturbances could be made out. Her reflexes were normal throughout.

Comment—This woman presented a very typical story of root pains together with local nerve involvement but without marked general signs of cord compression. The one feature calling for comment is the technical one concerned with the operation. When a tumor of considerable size (as this one was) lies underneath the cord, especially in the cervical region it is of the utmost importance not to confuse the cord in any manipulations necessary to remove the growth. This means that the tumor cannot be "delivered" in the usual way by tilting

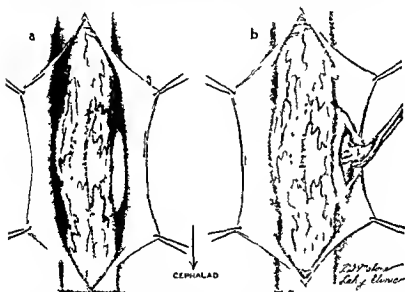


Fig 209—Case 1 *a* Position of tumor with respect to overlying spinal cord as seen upon exposure of cord *b*, Incision into tumor and removal piecemeal with subsequent withdrawal of capsule

it out from its position under the cord because in so doing the cord might be irretrievably injured and complete paralysis result. For this reason it is better first to remove the contents of the tumor capsule sufficiently so that the remaining portion may then be drawn out without further compressing the cord. In this way complete extirpation of the growth is accomplished.

A second instance of extramedullary cervical tumor with a somewhat different story is the following:

CASE 2.—H. G. a man 59 years of age was referred by Dr. W. B. Scoville of Hartford, Connecticut on September 29, 1939. The patient's chief complaints were

- 1 Pain in the left arm, shoulder and chest—five years
- 2 Difficulty in controlling left leg—one year
- 3 Progressive numbness in feet—one year
- 4 Spells of terror at night—one to two years

Present illness The patient had had a dull aching pain along the inner border (ulnar) of the left arm, under the left shoulder and in the left clavicular region most of the time during the five years previous to his admission.

This pain was aggravated when he was tired. It disappeared when he lay down and returned when he stood up. The pain had become extremely severe during the three weeks previous to his admission.

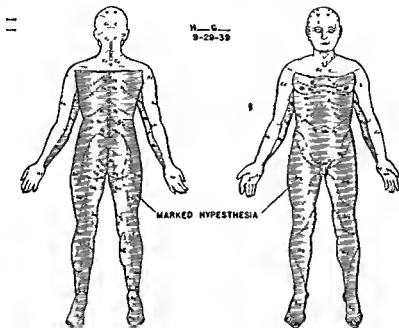


Fig. 210 Case 2 Chart showing loss of pain and vibratory sensation

About one year previously he noted that he had slight difficulty in controlling the movement of his left leg and that his left foot began to drag. These symptoms had become worse during the three months before his admission and his right leg had become similarly involved.

A rather unusual symptom was the sensation of terror at night precipitated he believed, by a sense of choking or tightness in his neck or in the abdomen. He had become constipated and was obliged to use cathartics regularly.

Neurologic examination disclosed generalized weakness and spasticity of both legs with all deep reflexes exaggerated bilaterally at the elbows, knees and ankles. The abdominal reflexes were absent and plantar stimulation produced dorsal flexion of the great toe on both sides. Both legs showed marked ataxia in the heel to shin tests.

Sensation. Pain sensation was absent bilaterally over the legs and trunk up to

the level of the eighth cervical dermatome. Vibratory sense was absent on the right side only up to the same level (Fig 210).

At the time of admission the patient had complete urinary retention.

A spinal fluid examination had been made at another hospital prior to the patient's coming to Boston. This disclosed xanthochromic fluid with a total protein content of 969 mg per cent. There was a complete subarachnoid block. Lipiodol had been injected into the lumbar canal and showed complete arrest at the level of the seventh cervical vertebra. Following the lumbar puncture and the injection of lipiodol the patient had developed urinary retention together with an increase in the weakness and numbness of his legs.

Operation, September 30 1939 A laminectomy from the fifth cervical to the first thoracic vertebrae inclusive was carried out. An encapsulated extramedullary tumor was found on the left side compressing the cord downward and to the right. The growth was removed intact after dividing the nerve root at its upper pole to which it was attached and from which it had arisen.

The patient made an uneventful convalescence and began to void spontaneously after three days.

Follow-up report January 17 1941 (one year and three months postoperatively). The patient stated by letter that he was well and working at his usual occupation.

Comment—Two interesting features are brought out in the story of this patient. First, there is the unusual history that pain disappeared when lying down and returned when he stood up. This is exactly the reverse of what transpires with most patients having spinal cord tumors and is more characteristic of a ruptured intervertebral disk.

The second point is the aggravation of the symptoms of cord compression after spinal puncture. Although the latter is a necessary procedure in most instances of spinal cord tumor, nevertheless its possible danger should be appreciated and it should be performed as a rule only when a laminectomy for the removal of the tumor can be instituted promptly. Such an arrangement had been made in this instance for the immediate transfer of the patient to Boston.

2. Thoracic Region

Extramedullary tumors throughout this area tend to produce root pains according to the level involved. If the growth is in the upper thoracic region pain is likely to occur in the chest simulating cardiac pain or there may be pain in the shoulder or scapular region which at first may be taken for arthritis or bursitis. In the lower thoracic area abdominal pain may present difficulty in the differential diagnosis from acute intra abdominal conditions or there may be pains in the legs simulating tabes or circulatory disorders. Again the first symptoms may be insidious numbness of the legs with very gradually increasing weakness of the legs such as is seen in degenerative lesions of the cord. In general root pains are somewhat more characteristic of the neurofibromas in contradistinction to the meningiomas as brought out by the following case reports.

- 1 Pain in the left arm shoulder and chest—five years
- 2 Difficulty in controlling left leg—one year
- 3 Progressive numbness in feet—one year
- 4 Spells of terror at night—one to two years

Present illness The patient had had a dull aching pain along the inner border (ulnar) of the left arm, under the left shoulder and in the left clavicular region most of the time during the five years previous to his admission.

This pain was aggravated when he was tired. It disappeared when he lay down and returned when he stood up. The pain had become extremely severe during the three weeks previous to his admission.

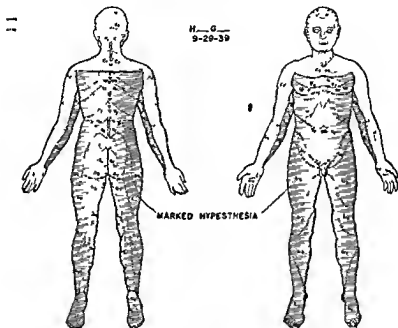


Fig. 210—Case 2 Chart showing loss of pain and vibratory sensation

About one year previously he noted that he had slight difficulty in controlling the movement of his left leg and that his left foot began to drag. These symptoms had become worse during the three months before his admission and his right leg had become similarly involved.

A rather unusual symptom was the sensation of terror at night, precipitated he believed, by a sense of choking or tightness in his neck or in the abdomen. He had become constipated and was obliged to use cathartics regularly.

Neurologic examination disclosed generalized weakness and spasticity of both legs with all deep reflexes exaggerated bilaterally at the elbows, knees and ankles. The abdominal reflexes were absent and plantar stimulation produced dorsal flexion of the great toe on both sides. Both legs showed marked ataxia in the heel to shin tests.

Sensation Pain sensation was absent bilaterally over the legs and trunk up to

the fourth thoracic vertebrae inclusive. A small encapsulated tumor lying on the right side of the cord was disclosed and removed intact. Since it was adherent



Fig. 212.—Case 3. Roentgenogram of spine after lumbar lipiodol injection showing filling defect at lower border of tumor (arrow) opposite the third thoracic vertebra.



Fig. 213.—Case 3. Photograph of tumor removed at operation. Dural attachment (arrow) removed with tumor.

to the dura, a portion of the latter was removed in order to be sure of excising all tumor cells (Fig. 213).

CASE 3—P L a man of 44 was referred by Dr H Magendantz and was admitted to the New England Deaconess Hospital on July 28 1938 complaining chiefly of pain in the right chest for one year

History The patient's pain had been of sudden onset about a year previous to admission, occurring in the right chest and shoulder. There had been some improvement in the original severe pain but it gradually settled under the right nipple and was aggravated by sneezing and coughing. A sudden turn would produce pain shooting into the front of the right chest. In addition to the pain during the two months previous to admission there had been a gradual progressive weakness and numbness of both legs.

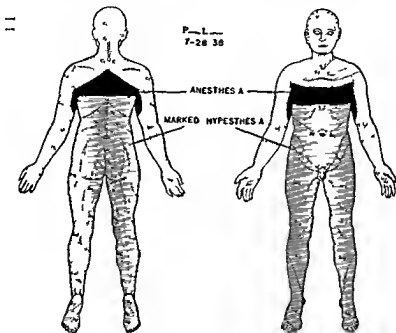


Fig 211—Case 3 Chart of partial loss of sensation to all modalities up to the level of the third thoracic dermatome

Neurologic examination disclosed general weakness of both legs and hyperesthesia to all forms of sensation below the level of the third thoracic dermatome (Fig 211). Light touch and pain were most disturbed between the third and sixth dermatomes. Vibratory sense was decreased over the left ankle. Stereognostic and position sense were normal throughout.

The deep reflexes were overactive and equal at both knees and both ankles and Babinski's sign was positive bilaterally. The abdominal and cremasteric reflexes were absent on both sides.

A hypodermic injection had been performed elsewhere and demonstrated a cup-shaped defect but not a complete block at the level of the third thoracic vertebra (Fig 212).

Operation was performed on July 30 1938 a laminectomy of the second to

the fourth thoracic vertebrae inclusive. A small encapsulated tumor lying on the right side of the cord was disclosed and removed intact. Since it was adherent



Fig 212—Case 3 Roentgenogram of spine after lumbar lipiodol injection showing filling defect at lower border of tumor (arrow) opposite the third thoracic vertebra



Fig 213—Case 3 Photograph of tumor removed at operation. Dural attachment (arrow) removed with tumor

to the dura, a portion of the latter was removed in order to be sure of excising all tumor cells (Fig 213)

nee and was discharged on August 1934 for a fibroma and not a meningioma.

In contrast to the previous case in which root pains were an early and persistent clinical feature, the following case of a meningioma at approximately the same cord level may be cited.

CASE 4—R. F. A woman of 45 was referred by Dr. J. C. McAdams and was admitted to the New England Deaconess Hospital on July 16, 1934.

History.—Four months previous to admission the patient had first noticed that her right leg and foot were getting weak and that both legs felt increasingly

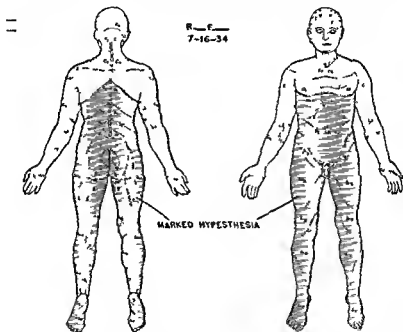


Fig. 214—Case 4. Chart showing sensory loss to all modalities up to the fifth thoracic dermatome.

numb. In addition to the numbness there was a "crawling sensation" in her legs below the knees. These symptoms persisted and within two to three weeks before her admission the left leg also became weak and she noted that the numbness in her legs had spread upward to the upper part of her chest. She was unable to walk during the ten days before coming into the hospital and she had had some "burning pain" in the lower back and the right hip. She had likewise become increasingly constipated.

Neurologic examination.—Both legs were extremely weak in all muscle groups and there was marked sensory loss of all modalities up to the fifth thoracic dermatome (Fig. 214). Vibratory sense was present but diminished. All the deep

reflexes were overactive and equal throughout at elbows knees and ankles and plantar stimulation produced dorsal flexion of the toes on both sides. The abdominal reflexes were inactive on the right and left.

Lumbar puncture demonstrated a complete subarachnoid fluid block. The total protein content of the spinal fluid was not determined due to an insufficient quantity of fluid.

A cisternal injection of lipiodol was carried out on July 18, 1934, and the subsequent roentgenograms showed a filling defect at the level of the third tho-



Fig. 215—Case 4. Roentgenogram of spine after cisternal lipiodol injection. Filling defect outlines the tumor (arrow) at the level of the third thoracic vertebra.

racic vertebra. The shape of this defect suggested an extramedullary tumor (Fig. 215).

Operation.—On the same day that the lipiodol injection had been made a laminectomy of the first to the fifth thoracic vertebrae was performed. An extramedullary tumor adherent to the dura on the left side, was disclosed at the level indicated by the filling defect (Fig. 216). The tumor was removed intact, including its dural attachment. One sensory root was divided as it was adherent to the growth.

The pathologic diagnosis was a meningioma. The patient made an excellent recovery and was discharged nineteen days postoperatively.

Follow-up report—On November 3, 1934, the patient reported for a check up examination. She was in excellent condition and had regained nearly all her former strength and sensation. She had an occasional slight pain in the back.

Comment—The 2 cases just cited had extramedullary tumors involving the cord at approximately the same level. In the former, root pains throughout the chest and shoulder were a prominent feature in the history and the growth was a neurofibroma. In the latter, a meningioma, pain was conspicuous by its absence, whereas a gradually

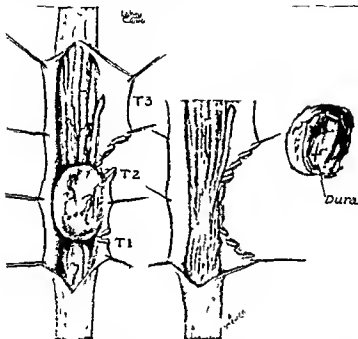


Fig 216—Case 4 Drawing of the tumor as seen at operation showing removal of dural attachment as well as of tumor

increasing motor and sensory paralysis which became almost complete was the outstanding feature. This is not necessarily characteristic of the two types of tumor but is at least suggestive.

An example of a low thoracic tumor may be given briefly in order to bring out certain features causing confusion between the correct diagnosis and intra abdominal disease.

CASE 5—H S, a young woman 20 years of age was admitted to the New England Baptist Hospital on November 18, 1933.

History For several years she had had intermittent pain in the upper abdomen radiating to the back, and although this pain was brought on by sudden

turning sneezing and coughing nevertheless she was treated for a gastrointestinal disorder and was seen by a general surgeon with a question of appendicitis. She had had difficulty with her bowels, requiring daily cathartics. A few months before admission she had experienced numbness and coldness of the feet and her right leg had become progressively weak.

Neurologic examination disclosed slight atrophy of the right thigh and lower leg together with weakness of the right leg in all muscle groups. There was lessened sensation to all modalities over the anteromedial aspects of both thighs, more especially the right. The deep reflexes were exaggerated and equal at both knees and both ankles, with an unsustained ankle clonus on the right. Babinski's

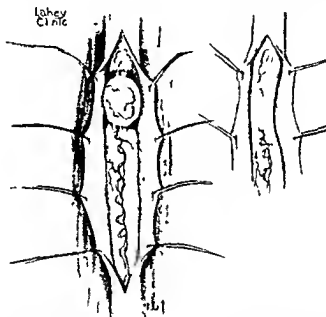


Fig. 217.—Case 5. Drawing of tumor as seen at operation. Sketch at right shows marked compression of the dorsal surface of the cord after tumor removal.

sign was positive on both sides. Lumbar puncture yielded xanthochromic fluid but a complete subarachnoid block could not be demonstrated.

Lipiodol was injected into the cisterna magna since the exact level of the spinal lesion was not apparent from the other neurologic data. There was complete arrest of the lipiodol at the level of the ninth thoracic vertebra.

Operation, November 22, 1933. On this date a laminectomy of the seventh to the eleventh thoracic vertebrae was performed. A rounded extramedullary tumor was disclosed at the level indicated by the lipiodol injection and this tumor was completely removed intact (Fig. 217). It was a smooth, almost spherical growth (Fig. 218). The pathological report of the tissue showed that it was a neurofibroma.

The patient made an excellent recovery and was discharged on the twentieth postoperative day

Follow-up report, October 27, 1936 Three years after operation the patient wrote that she was perfectly well.

Comment—The one point to be emphasized in connection with this patient is the situation and character of the pain which for several years was supposed to be due to some intra abdominal condition. Sufficient attention was not paid to the fact that her pain was brought on by the usual stimuli which aggravate root pains, namely sneezing



Fig. 218—Case 5 Photograph of the tumor removed at operation (natural size)

coughing or other types of straining which raise the intraspinal pressure. It was not until numbness and weakness of her legs was complained of that the correct diagnosis was made by neurologic investigation.

3 Lumbar Region (Cauda Equina)

Tumors involving the cauda equina as might be supposed, are prone to simulate a variety of conditions causing low back pain, pelvic pain and pain down the legs such as may be produced by a ruptured intervertebral disk. The pain is likely to be of long duration, sometimes several years, and patients are not infrequently treated without relief for a considerable period before the real diagnosis is disclosed. Because of the facts just mentioned, patients with low back and sciatic pain should almost always have a careful neurologic examination and

in many instances lumbar puncture studies if relief by ordinary simple measures is not promptly secured

Two characteristic examples of tumors in this area may be cited briefly

Case 6—E. A. S., a woman physician 60 years of age, was admitted to the New England Baptist Hospital on May 29, 1933

History For many years, i.e., since 1920, the patient had had periods of low back pain, and a year and a half before admission she had begun to have pain extending down both thighs, especially on the right side. At that time a diagnosis

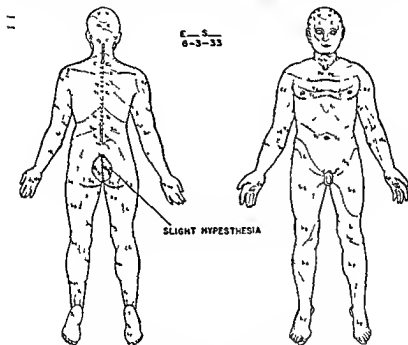


Fig 219—Case 6 Chart showing partial loss of pain sensation over fourth and fifth sacral segments

of "abnormal sacro-iliac mechanism arthritis and traumatic sciatic neuritis" had been made and she was treated conservatively. Her pain became extremely severe about one month before admission, and five days before coming to Boston she was confined to bed with excruciating pain down the right leg. She was brought to the hospital in an ambulance. Orthopedic manipulation and a procaine injection into the right sciatic nerve as an emergency measure gave no relief.

Examination She was then seen in consultation and the following positive features were made out

1. Tenderness over the lumbosacral junction.
2. Hypesthesia to pin prick over the fourth and fifth sacral dermatomes (Fig 219)

3 Absent ankle jerks on both sides

There was no muscular atrophy or weakness of the legs her knee jerks were equal and active and the plantar responses were normal.

Lumbar puncture on May 31 1933 disclosed deeply xanthochromic fluid and apparently a complete subarachnoid fluid block. The total protein was not recorded. On June 3 1933, a *lipiodol* injection was made into the cisterna magna and a tumor at the level of the fourth lumbar vertebra was outlined.

Operation. On June 6 1933 a lumbar laminectomy was carried out and a rounded encapsulated tumor attached to one strand of the cauda equina was completely removed. At the time it was diagnosed pathologically as a meningioma but was probably a neurofibroma (Fig 220). The patient made a relatively good convalescence aside from a mild bladder upset with tenesmus. She was discharged greatly improved and without her previous pain on June 28 1933.

Follow up report on February 2, 1934 stated that she was quite well except for a little low backache.

Comment—The roentgenograms of this patient have been destroyed since the hospital does not have sufficient room to store them for more than a few years but the filling defect with *lipiodol* was similar to those illustrated in some of the previous cases.



Fig 220—Case 6 Photograph of the tumor removed at operation (four fifths natural size)

This patient was seen in the days previous to the spread of information concerning ruptured intervertebral disks but her symptoms simulated such a lesion and if such a patient were seen today a neurologic consultation together with a lumbar puncture would almost certainly have been carried out at a much earlier stage of her illness. It is highly probable too that an oxygen spinogram outlining the lumbar region would now be utilized instead of the *lipiodol* injection into the cisterna thus sparing the patient this added procedure.

CASE 7—I McV a woman of 41 was admitted to the New England Deaconess Hospital on August 7 1940.

History The patient had complained of pain in the back and in the left hip since February 1939. She also had pain to some extent down both legs particularly the left. Because of this pain she had been subjected else where to an operation for a supposed hernia after traction applied to the left leg had given no relief. She was then put into a plaster cast for six weeks. There was some slight relief following this procedure, but her pain recurred and increased in severity.

so that she was unable to get about without considerable pain even though she took medication regularly. She had been unable to sit in a chair comfortably for over a year.

Neurologic examination No loss of strength in the legs could be made out nor were there any sensory changes although particular attention was paid to the lumbar and sacral areas. Straight leg raising was positive on the left. The knee jerks were normal, but the right ankle jerk was diminished although both were present.

Lumbar puncture yielded slightly xanthochromic fluid with a partial block and a total protein of 900 mg per cent. This puncture was repeated, and on the second occasion no block could be demonstrated and the total protein was 67 mg per cent.

An oxygen spinogram was carried out and the rounded shadow of a presumed tumor was outlined with its upper border at the level of the third lumbar vertebra (Fig 221).



Fig 221—Case 7 Oxygen spinogram showing rounded tumor shadow (arrow) at the third lumbar level

Operation, August 9, 1940 On this date a lumbar laminectomy was performed and an encapsulated tumor attached to one strand of the cauda equina was removed.

The pathologic examination of the growth showed it to be a neurofibroma.

The patient made a good recovery from the operation and was discharged on August 27, 1940. At that time her pain had not been completely relieved, but was considerably better.

Follow up report, November 25, 1940 The patient still had a certain amount of pain, especially when sitting but on the whole was doing very well and was largely relieved.

Comment—It is to be noted that from the purely neurologic standpoint there was extremely little to be made out in this patient's ex-

amination, there being no motor loss or sensory change in the lower extremities. The slightly diminished right ankle jerk and the positive straight leg raising test on the left indicated a lumbar lesion, but the discrepancy in sides was confusing. The diagnosis, therefore, could be made only on the basis of the lumbar puncture and the more exact location of the lesion was disclosed by the spinogram. The outline of the tumor against oxygen does not always come out clearly when reproduced, but is shown perfectly in the roentgenograms themselves.

GENERAL DISCUSSION

As will be seen by the foregoing case reports, extramedullary spinal cord tumors characteristically produce two varieties of symptoms, namely, those due to local compression of the spinal nerve roots at the level of the growth, and later those due to pressure upon the spinal cord itself. In the early stages, before the advent of spinal cord compression, the various types of pain resulting from involvement of one or more nerve roots may simulate a variety of conditions from which a differential diagnosis must be made. In the cervical region some of the more usual conditions requiring differential study are cervical rib (scalenus syndrome), ruptured cervical disks, bursitis, brachial neuritis, cardiac lesions and cervical arthritis. Tumors involving thoracic nerve roots may also produce pain which is suggestive of cardiac disturbances as well as acute abdominal conditions such as gallbladder and kidney colic or appendicitis. When the strands of the cauda equina are compressed by a tumor, the resulting pain is often in the sciatic distribution, and therefore may be mistaken for a ruptured intervertebral disk, pelvic tumor compressing the sciatic nerve, sacroiliac disease or some form of neuritis.

In most patients with these conflicting symptoms the differential diagnostic features will either be quite obvious or not difficult to ascertain. When there is uncertainty, a careful chronological history combined with an equally careful neurologic examination will almost always give a clue to the central nervous system origin of the pain or other symptoms. Unless a definite diagnosis can be made not only of the nature of the spinal lesion but also of its exact site, the next step would be roentgenograms of the spine to see if any bony erosion were present. If the roentgenograms prove to be negative as is often the case, a lumbar puncture should then be carried out particularly with the idea of establishing the existence or nonexistence of a subarachnoid fluid block, together with a determination of the total protein contents of the spinal fluid, the latter being almost invariably considerably elevated in the presence of a spinal tumor. When there is a complete block the fluid is xanthochromic and the total protein may run as high as 1000 to 4000 mg per 100 cc, but usually it is far lower than this.

Since the exact level of a spinal cord tumor cannot always be determined by the history and neurologic examination it is often neces-

sary (or advisable for more accurate localization) to introduce some form of contrast medium into the spinal subarachnoid space so that

repair

for this and carry out the necessary injection at the same time that the diagnostic lumbar puncture is performed in order to spare the patients a second procedure of this kind. This is always possible with the helpful cooperation of the x-ray department. If a complete block exists we prefer to use oxygen or air for contrast since either of these shows a perfectly adequate usually somewhat rounded defect in the column at the level of the tumor and furthermore these gases are quickly absorbed whereas pantopaque or lipiodol have to be removed and removal may not always be complete thus leaving a foreign substance within the spinal canal.

It may be said once more as stated in connection with Case 7 that

Lumbar puncture as a diagnostic measure in spinal cord tumors has been criticized on the basis that at times symptoms and signs of serious cord compression will follow its performance. This is unquestionably true and for this reason we believe that such punctures should be done only when facilities as to hospital and surgeon are available for an immediate laminectomy should this prove necessary. It is hardly necessary to add that contrast media are indicated only when the exact location of the tumor cannot be ascertained by other means.

Treatment—The only treatment for extramedullary spinal cord tumors is complete removal. This can be accomplished in practically every case the exceptions being the occasional extensive giant cell tumors of the cauda equina and certain instances of meningiomas involving the upper cervical cord as well as the region of the medulla and the lower group of cranial nerves. Even these at times can be removed completely or so radically that many years of perfectly normal existence ensue.

Mortality—Laminectomy for the complete removal of extramedullary spinal cord tumors is an operation which should carry a minimal risk. Among the 53 patients with this type of lesion in the records of the Lohry Clinic since November 1, 1932 there has been one operative death* a mortality of 1.8 per cent.

* Death from any cause after operation while patients are still in the hospital is considered an operative death.

TUMORS OF PERIPHERAL NERVES

KENNETH E. LIVINGSTON AND NELSON HASTINGS

of an ... for this reason that they assume considerable clinical importance. The ...

... physician and it is important that the potential danger of the lesion be recognized at a time when the possibility of

rogenic" although they are an of the neuron

Tumors arising from a peripheral nerve may occur anywhere along its course from the point of exit at the intervertebral foramen to the terminal ramifications in the skin. Symptoms will vary with the location, size and rate of growth of the ...

... in the neurofibromatosis of von Recklinghausen's disease where in its multiple forms it has been described as "molluscum fibrosum," "cutaneous neurofibroma," "elephantiasis neuroomatosis" and so forth. The subcutaneous lesion may be mistaken for a lipoma fibroma ganglion cyst hernia wen and lymph node. In the deeper tissues the lesion will be recognized only when it becomes visible, palpable or painful. It is uncommon for these tumors to produce objective motor or sensory disturbances.

Not all of the neurogenic tumors are true neoplasms. The traumatic neuroma that forms after injury or interruption of the nerve is reparative rather than neoplastic and the typical lesions of von Recklinghausen's disease are considered to be secondary to a generalized genetic defect in the nervous system rather than to neoplasia. It is important, however, to note that true neoplastic change may frequently be superimposed on the lesions of von Recklinghausen's disease.^{2, 5, 7, 10, 14}

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... the central nervous system. They are not tumors of the peripheral nerve and will not be considered in this discussion.

One of the principal obstacles to the establishment of rational standards for the treatment of the neurogenic tumors is the apparent confusion existing in their pathologic classification and nomenclature.

Essentially, these tumors must be derivatives of the cells which make up the peripheral nerve. Distal to its exit from the spinal canal the nerve consists of axons of the motor, sensory and sympathetic neurons plus the various sheath tissues. The primary sheath for each axon is the Schwann cell tube. Schwann cells are ectodermal in origin, arising from the neural crest and migrating distally to form tubes for the axons as the nerve develops.⁸ The remaining sheath structure of the nerve is modified fibroblastic connective tissue, and consists from within outward of the endoneurium which surrounds and supports the Schwann cell tube, the perineurium which surrounds each of the interior bundles of nerve fibers, and the epineurium which invests the entire nerve trunk. Thus there are two cell types from which neoplasms of the peripheral nerve may arise—the ectodermal Schwann cell, and the mesodermal sheath fibroblast. Both cells are sheath constituents so that their tumors may be grouped as tumors of the nerve sheath. There is considerable disagreement over which of these cell types is the source of the typical tumors of peripheral nerves. If it could be established that the malignant tumors are derived from one cell type and not from the other, then microscopic differentiation as to the origin would be of great clinical importance. No such segregation has been possible, however, and the essential problem remains the differentiation of the potentially and frankly malignant tumors from those that are benign.

In order to clarify the clinical conception of these tumors they may be divided into the following groups:

- 1 Neuroma
- 2 Neurofibroma
 - a Cutaneous
 - b Diffuse—von Recklinghausen's disease
- 3 Palisaded nerve sheath tumor
- 4 Nonpalisaded nerve sheath tumor
- 5 Neurogenic sarcoma

The Neuroma.—This is not a neoplasm but rather represents an attempt at repair and regeneration following injury. Axis cylinders and sheath tissues all participate in a proliferative reaction. Microscopic sections show bundles of axis cylinders in parallel arrangement surrounded by dense irregular fibrous tissue. The picture is seen most typically in the 'amputation' neuroma following nerve interruption.

The Neurofibroma.—Lesions of this type are among the most common tumors and can be found in some form on nearly every patient examined. They usually occur as soft nodules in the skin and are frequently excised for cosmetic reasons. The lesion is characterized by

a localized marked increase in fibrous tissue and collagen with a tangled proliferation of wavy parallel fibrils in which enmeshed or wandering axis cylinders can be found. Many of these tumors undergo a jelly like hyaline degeneration. They can normally be excised without recurrence, but within the cutaneous lesions compact areas typical of the palisaded or nonpalisaded sheath tumor may be found, and transition from these foci to actual malignancy sometimes occurs. In a series of 69 neurogenic sarcomas which we studied, approximately 10 per cent were cutaneous lesions. These lesions should all be curable if the diagnosis of malignancy is made at the time of initial excision and an adequate resection is carried out.

In von Recklinghausen's disease, the neurofibromatous changes are found on both superficial and deep nerves and may result in a diffuse thickening or in discrete nodular enlargements. The presence of en-

is significant since studies of von Recklinghausen's disease have shown that sarcoma occurs in 13 to 15 per cent of cases.^{3, 14} In a series of 40 patients with von Recklinghausen's disease, studied by Geschickter,

the neurofibromas

The Palisaded Sheath Tumor.—This is a well defined lesion although it has received many different labels—"neurilemonia" (Stout), "perineurial fibroblastoma" (Penfield), "palisaded neurinoma" (Geschickter), "neurofibroma" (Ewing), "Schwannoma" (Masson), and so forth. It is the common tumor of the spinal nerve root and the acoustic nerve, and in its pure form may be considered benign.^{7, 12} It is typically a solitary rounded encapsulated tumor attached to any except the intracutaneous nerves. The cut surface is brownish yellow,

As the lesion develops it displaces the nerve bundles so that axis cylinders will never be found within the tumor.

Unfortunately, the pure palisaded tumor constitutes only about one-third of the nonmalignant tumors of the nerve sheath.⁷ The remainder show varying deviation from the palisaded type and are probably intermediate in growth potential between the benign lesion and the sarcoma. It is the atypical forms of the apparently benign sheath tumor which are clinically dangerous and for this reason they are considered separately as the nonpalisaded sheath tumor.

The Nonpalisaded Sheath Tumor.—The chief histologic features of this tumor are its lack of complete encapsulation, absence of typical palisades and the presence of areas where the cell nuclei seem to have disappeared, leaving behind a fine reticular stroma (Fig 223). These lesions have none of the common stigmata of malignancy, yet Geschickter⁷ found that 30 per cent of the deeply situated tumors of this type, which he labeled "myxoid neuroma," recurred following removal and over half of the recurrences were malignant and fatal.

Sheath tumors of the deep nerves that deviate microscopically from the typical palisaded tumor must, therefore, be treated as potentially



Fig 222.—Palisaded nerve sheath tumor. The swirling patterns and parallel arrangement of nuclei in "palisades" are clearly shown, and are the chief characteristics of this tumor.

malignant lesions. They should be excised widely at the original operation and the patients must be followed closely for evidence of recurrence. Recurrence in this group of tumors is extremely serious, and for this reason the practice of splitting the nerve to "shell out" such a lesion is dangerous and unwise.

Neurogenic Sarcoma.—Sarcomas arising from the nerve sheath are probably the most common soft part sarcomas. The cellular pattern of these lesions will suggest the benign tumor more or less, depending upon the r.
(Fig 224)
nancy which

fatal sarcoma that metastasizes widely. It is probable that a large proportion of these sarcomas represent malignant change in preexisting benign lesions^{2, 7}—a fact which should make imperative the critical classification and follow up of the “benign” lesions. The probability of malignant change in the benign lesion is suggested by the histories of patients who seek medical advice because a superficial lesion present for many years or since childhood “begins to grow” and on excision proves to be a neurogenic sarcoma.¹ In most instances sudden growth in a preexisting “inactive” nodule will be indicative of malignant



Fig. 223—Nonpalisaded nerve sheath tumor. The lack of uniformity in organization and tissue pattern in this tumor is marked in comparison with the lesion shown in Figure 222. Other areas of this tumor show some swirling and palisade formation which identify it as a nerve sheath derivative, but the loose myxoid structure shown above is the dominant characteristic of this lesion.

change. The actual transition to malignancy can occasionally be followed in the successive recurrences of an initially “benign” lesion that progresses to clinical and microscopic frank malignancy as in the following case:

CASE 1—A patient aged 30 had a “lump” on the extensor surface of the left forearm for five years prior to the original excision in 1941. The lesion recurred and in 1945 was biopsied. Microscopic sections from the tumor in 1941 and 1945 showed an identical “benign” sheath tumor. Within one year, however, the tumor had rapidly recurred and at operation in 1946 proved to be neurogenic sarcoma. Figure 224 is a section from this lesion.

If recurrence takes place it will be evident in the majority of cases within a year following the primary excision, and the local recurrence will almost always precede distant metastasis.¹⁵ Metastasis is typically to the lung. In the presence of local recurrence the prognosis is grave, and for this reason it is imperative that the diagnosis be established at the time of the original operation so that the excision may be adequately radical. In a large series of sarcomas studied by Geschickter⁷ none of the deep lesions was cured except by amputation. This indicates the difficulty of carrying out adequate local excision of the deep sarcoma. If adequate margin in all directions cannot be ob-



Fig. 224—Neurogenic sarcoma. This is a densely cellular lesion with areas that suggest swirling patterns of the typical sheath tumor. The "benign" lesion from which this sarcoma apparently derived was first noted in 1936. It recurred slowly following excision five years later (1941) but grew rapidly after biopsy in 1945. This section is from the excision done in 1946 (see Case 1 in text).

tained at the time of initial excision of an extremity lesion, amputation is fully justified. Recurrence is certain to occur following inadequate excision, and with recurrence, amputation will probably be necessitated. The prognosis for cure at that time (usually within one year of initial excision) will be greatly reduced.

Radiation therapy is not of significant value in the treatment of these lesions.¹¹

There is no dependable difference in the distribution of the benign and malignant tumors, and scatter patterns of the two lesions are essentially similar.^{7, 11, 12}

SUMMARY

Tumors of the peripheral nerves deserve more serious consideration than they generally receive. Recurrence of the apparently "benign" nerve sheath tumor is dangerous and frequently terminates in fatal malignancy. A high percentage of these lesions should be cured and it is quite evident that the optimal time for cure is with the primary excision. Many failures to obtain cure are attributable to the fact that the diagnosis of potential or actual malignancy was not made at the time the lesion was initially excised.

Any soft part tumor for which excision is indicated deserves immediate microscopic study of a frozen section so that the surgeon can carry out an adequate primary excision.

We wish to express our appreciation to Dr. Shields Warren and Dr. W. A. Meissner for the opportunity to review the peripheral nerve tumors of the New England Deaconess Hospital Laboratory of Pathology.

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CANCER OF THE THYROID

HUGH F HARE

THYROID tumors may be divided into benign and malignant types. A feasible and workable classification suitable to most histologic variations has been developed by Dr Shields Warren and is shown in Table 1.

TABLE 1
HISTOLOGIC CLASSIFICATION
(Shields Warren)

Benign

- 1 Adenoma
 - a Embryonal
 - b Fetal
 - c Simple
 - (1) Hurthle cell
 - d Colloid
- 2 Papillary cystadenoma
 - a Originating from thyroid
 - b Originating from aberrant thyroid

Malignant

- Group I Low or potential malignancy
 - 1 Adenoma with blood vessel invasion
 - 2 Papillary cystadenoma with blood vessel invasion
 - a Originating from thyroid
 - b Originating from aberrant thyroid
- Group II Moderate malignancy
 - 1 Papillary adenocarcinoma
 - 2 Alveolar adenocarcinoma
 - 3 Hurthle cell adenocarcinoma
- Group III High malignancy
 - 1 Small cell carcinoma (carcinoma simplex)
 - a Compact type
 - b Diffuse type
 - 2 Giant cell carcinoma
 - 3 Epidermoid carcinoma
 - 4 Fibrosarcoma
 - 5 Lymphoma

Between the years 1926 and 1936 240 patients with malignant type were treated with a subsequent follow up of five years or more. The types of malignant tumors encountered according to their histologic classification are shown in Table 2.

It is apparent from Table 2 that the potentially malignant group represented a high percentage of the so-called malignant tumors of the thyroid gland, since 108 of 240 (45 per cent) belonged to the low or potentially malignant group. Many experienced histologists do not agree that lesions in Group I should be considered malignant, and it is true that they do not fulfill all the necessary criteria, yet because they do invade and because they do recur locally and distally, they must be included until a better method of determining their importance is established.

In papillary adenocarcinoma, a portion of the preexisting adenoma may still be distinguishable and in several cases we have seen papillary adenocarcinoma encapsulated within a fetal adenoma. These tumors may be divided into two classes, those with papillary projections and those in which only small acini along with large, irregular cell masses are observed. The papilliferous form may be readily distinguished from the papillary cystadenomas by the occurrence of solid masses and clusters of tumor cells as well as by a more marked degree of anaplasia than occurs in cystadenoma.

TABLE 2

TYPES OF MALIGNANT TUMORS IN 240 CASES (1926-1936)

	Cases
Adenoma with blood vessel invasion	61
Papillary cystadenoma	49
Papillary adenocarcinoma	39
Alveolar adenocarcinoma	38
Small cell carcinoma	39
Giant cell carcinoma	11
Sarcoma	3

In the alveolar adenocarcinoma there is a wide range of variation. In some the alveolar formation is marked and colloid containing particles may be present. In others there is but little suggestion of normal thyroid architecture with only slight maintenance of alveolar form. It is well recognized that this particular type of malignancy in all glands of the body is radioresistant and difficult to destroy. Frequently normal tissue may be injured before this type of growth is destroyed.

Alveolar adenocarcinomas (Group II) of the thyroid originate within the substance of the gland. This is well brought out by the histologic classification of malignant tumors of the thyroid as developed by Hartman and Grant. They classify their tumors according to whether or not the malignancy arose from preexisting adenoma. They, too, are of the opinion that tumors of Group I arise from preexisting tumors while the adenocarcinoma and the scirrhous carcinoma have no previously existing lesions.

Adenocarcinomas are firm, usually fixed to the surrounding structures, and give an asymmetric outline to the gland on palpation. Metastases to regional lymph nodes may be present at the time of examination. The amount of distortion of the gland varies with the duration of the disease and the size of the tumor. The patient often gives a history of gradual increase in size of the growth for a period of months and occasionally years.

One very rare form of adenocarcinoma is the Hurtle cell type, being a malignant variant of the Hurtle cell adenoma. The same large acidophilic cells are present in both, but in the adenocarcinoma they are much more variable, show more mitotic figures, and form irregular masses and clusters of cells invading the adjacent structures.

Giant cell carcinomas and sarcomas are rare but they represent a true histologic type. Lymphomas arising or present in the thyroid gland are similar in histologic appearance to those seen elsewhere in the body.

From the study of a large series of cases it can be assumed that in most instances the low or potentially malignant group arise in pre-existing tumors of the thyroid gland, and, from our records, usually in single adenomas, without evidence of toxicity. Since this group represents 45 per cent of the total cases of carcinoma of the thyroid, it readily follows that treatment of single adenomas of the simple type by surgery followed by x rays is advisable. It is true that the percentage of cures in this particular group of cases is higher than is seen with practically any other type of malignant disease. On the other hand, if these tumors are allowed to remain in the neck, they continue to grow and eventually control is not attainable.

The etiology of 55 per cent of tumors of the thyroid gland or of the more rapidly growing type of tumor is not known, but the history in this particular group of cases is usually of shorter duration than in those that arise from the single adenoma and the tumors more readily distinguishable clinically owing to their hardness, loss of distinct outline and fixation to surrounding tissue.

The occasional presence of lateral aberrant thyroid tissue and the frequent malignant degeneration seen in this tissue makes it advisable to discuss lateral aberrant thyroid.

In the course of embryonic development, thyroid tissue which persists outside of the thyroid gland proper is termed aberrant thyroid tissue. Aberrant tissue may be of lateral, medial or ectopic origin. It finds its origin in the ultimobranchial body.

The histologic appearance of this tumor is that of a papillary cystadenoma, usually with blood vessel invasion. Adult thyroid elements are not visualized. This makes it difficult to identify the tissue as of thyroid origin. The microscopic appearance of this papilliferous tissue is so characteristic and constant, however, that whenever a tumor is removed from the lateral region of the neck and is diagnosed

as papillary cystadenoma, it is in all probability a lateral aberrant thyroid and is actually or potentially malignant.

SIGNS AND SYMPTOMS OF THYROID MALIGNANCY

The clinical symptomatology and the physical signs to be noted in carcinoma of the thyroid depend on the stage of the disease present at the time the patient is admitted for examination. In the Group I potentially malignant tumors the history is usually of one to three years' duration. Occasionally the patient will note that within about a week to a month there has been a more rapid growth of the tumor. Not infrequently in our series, however, the early cases of malignancy were diagnosed as only simple adenomas unless the history was of long duration. In the cases in Group II and Group III there is usually no doubt as to malignancy; the patients have some evidence of venous compression usually with dilated neck veins, and a hard, fixed, infiltrating mass is found in the neck. Stridor may or may not be present, depending on the degree of encroachment upon the trachea. In the advanced cases evidence of secondary glandular involvement is found at the first examination unless the lesion arises from aberrant thyroid tissue. In these instances enlarged glands are the only evidence.

The thyroid state which will most often cause the observer with little experience in palpating thyroid glands wrongly to consider the thyroid is thyroiditis. When the thyroid is inflamed and occupied by round cell infiltration, it assumes such a condition of stony hardness as to resemble malignancy. The distinguishing diagnostic point between thyroiditis and carcinoma of the thyroid is that in malignancy the symmetry and contour of the gland is lost, while in thyroiditis the symmetry of the gland remains intact.

One feature indicating possible malignant degeneration of an adenoma of the thyroid which has existed for some time is a changed consistency from one of moderate firmness to one of induration. The two common causes of a change in consistency to one of unusual firmness in an adenoma of the thyroid are the occurrence of malignant degeneration within the adenoma and hemorrhage into the adenoma. The former occurs gradually without pain and localized tenderness. The latter occurs in a short period of time and is usually associated with pain and localized tenderness in the adenoma. In a discrete adenoma which has existed for some time with well defined and palpable outlines a loss of this sharply defined demarcation with diffusion of the firm tumor mass into the parenchyma of the gland should make one suspicious that malignant degeneration has taken place inside the adenoma, eroding through the capsule and involving the parenchyma and so causing the loss of the discrete outline of the thyroid tumor. Reaction about a thyroid adenoma into which hemorrhage

has taken place may produce some degree of fixation, but this is far less definite than is the fixation caused by malignant invasion from an adenoma. Tenderness following hemorrhage is an outstanding clinical sign. The firm attachment of the prethyroid muscles to any portion of the gland at operation is extremely suspicious evidence of the probability of malignant degeneration within the adenoma.

Hoarseness due to secondary involvement of the recurrent laryngeal nerve, causing paralysis of this nerve, is occasionally seen and is evidence of invasion.

Experience has shown that carcinoma or malignant degeneration of the thyroid adenoma may take place in an individual of any age and in any sized tumor. We know that youth and the size of the tumor at the time of examination should not be seriously taken into consideration in determining the diagnosis.

In the lateral aberrant tumor of thyroid origin the differential diagnosis is indeed difficult to make unless invasion of the surrounding tissues has taken place. They must be distinguished from all simple tumors of the neck. The most frequent mistake which we made early

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branchial

cleft cysts and glands secondary to tumors elsewhere in the body

It is important to note that malignant disease of the thyroid arises infrequently in toxic adenoma. In a ten year period, only 7 cases of malignancy were found in toxic adenomas and in 4 of these 7 cases malignancy occurred in multiple colloid adenomatous goiters with toxicity. Thus, the relatively infrequent occurrence of malignancy in toxic goiter arising in adenomas is demonstrated.

The roentgenogram is of little significance in determining the absence or presence of malignant disease within a tumor unless there is secondary invasion into the trachea or secondary pulmonary involvement. The relative frequency, however, of secondary malignant involvement in the lung is so great that it is deemed necessary in all cases of suspected thyroid cancer to take roentgenograms of the trachea and chest prior to treatment.

THERAPY

The primary treatment of malignant tumors of the thyroid gland is surgical. The low or potentially malignant group may be successfully treated by operation alone, although tumors falling into this group are radiosensitive and, because of frequent recurrences in this group, radiation treatment is advised following operation.

Surgery should be carried out in all cases of thyroid tumor to remove first, all of the tumor possible and second, to free the muscles of the neck so as to remove danger of compression of the trachea from edema following heavy radiation. In some cases when invasion

has taken place to such a degree that removal and freeing of the thyroid muscles is not possible a tracheotomy is advisable before radiation treatment is attempted. Radiation treatment may be started as soon as the patient recovers from the operative procedure without fear of preventing wound healing.

Radiation Treatment—Adequate radiation treatment should be delivered to the entire tumor bed but large fields which include considerable normal tissue should be avoided to prevent complications and late or subsequent injury of normal tissue. In young patients a certain degree of hypertrophic change of the bones of the cervical spine have been noted several years after radiation treatment.

Radiation treatment when given for carcinoma of the thyroid, must be of a great enough quantity to destroy tumor tissue completely and in some types the lethal tumor dose has been established. In some types such as the alveolar adenocarcinomas the tumor dosage required for destruction is so great that it is not advisable to treat a large field because of the degree of damage to the surrounding normal tissue. The probable cause of failure in the treatment of lesions other than the alveolar adenocarcinoma is the fact that metastases have already taken place outside of the tumor bed and consequently recurrence will take place outside the area treated. Infrequently a tumor does return in a previously treated tumor bed when supposedly

to be preferable

using one portal on each side of the neck and one in the midline being careful not to overlap the fields and aiming the x rays so that the greater percentage of the radiation will enter the tumor bed. The size of the portal depends on the size of the original growth and the degree of substernal extension which the tumor has attained. We have usually been able to use a 7 or 10 cm square portal on each side of the neck and in the midline without overlapping the fields and in this way we have covered the entire tumor bed. A total of 2000 r measured in air is given to each portal to make a total dose of 6000 r delivered to the skin during one series of treatment. Each portal is treated daily after the first three treatments giving 150 r units to each making a total of 450 r daily. If the patient is debilitated it is necessary to decrease the dose to 100 r to each portal daily. A total of 6000 r measured in air gives a dose of approximately 4800 r 2 cm beneath the skin area which is assumed to be the tumor bed dosage, although no direct measurements have been made in our cases. The following factors are used: k v p 200 milliamperes 20 r per minute 24 filter 1 mm of copper 1 mm of aluminum added distance 50 cm portal 7 to 10 square centimeters half layer value 13. Treatments are carried out daily except Sunday unless complications arise.

Complications of Radiation Treatment—The most common complication of radiation treatment is radiation sickness which may be easily controlled in most cases by decreasing the daily dose. The most important complication following radiation treatment is radiation dermatitis, a condition which is practically always seen following doses given as outlined. If the patients are properly reassured at the time the treatment is given and told that a sore throat will develop and that blistering of the skin will occur, they may be carried along satisfactorily without undue worry.

We have had only 1 case of slough following radiation treatment after operation. In this case extensive removal of thyroid and normal tissue was attempted following intensive radiation treatment and the operation was further followed by implantation of gold radon seeds. This followed an attempt to cure an almost hopeless malignancy and

TABLE 3
INCIDENCE OF MALIGNANCY IN THYROID ADENOMAS

Year	Total Thyroid Tumors	Malignant Per cent
1926	443	3.6
1927	501	4.0
1928	526	10.8
1929	655	7.8
1930	574	4.3
1931	504	3.5
1932	495	3.2
1933	426	3.5
1934	495	5.0
1935	433	3.5
Total	5052	

is one of those rare instances in which one attempts to do more than was justifiable.

small for ⁵conclusive determination that radiation treatment is not advisable. We have had many patients in Group I and Group II treated by radiation alone whose disease was too far advanced at the time of admission for operation to be carried out and who lived for a period of over five years. One significant point brought out by Portman's study is that in the results of operation alone in the cases in Group III, no patient lived a year following operation, while in a group of 41 patients who had operation followed by roentgen therapy 24 lived one year, 17 lived two years, 14 lived three, 11 lived four

and 10 patients lived five years. The five year survival rate was 14.6 per cent in the very severe type of tumor and excellent palliative results were obtained in more than half of the cases for over a year, years

incidence of malignant disease was 10.8 per cent, while in 1932 it dropped to 3.2 per cent. It is most interesting, however, to note that over a ten year period from 1926 to 1936, 1971 simple adenomas of the thyroid gland were removed. During this period 236 malignancies of the thyroid gland were encountered, to give an incidence of 12 per cent.

TABLE 4

CARCINOMA OF THYROID TREATED BY SURGERY AND RADIATION
FIVE YEAR SURVIVAL RATE, 231 CASES

	Per cent	
Fetal adenoma	71	} 45% of total
Papillary cystadenoma	62	
Papillary adenocarcinoma	80	
Alveolar adenocarcinoma	27	
Small cell carcinoma	22	
Giant cell carcinoma	17	
Fibrosarcoma	33	

It is equally important to realize that the frequency of malignant disease in multiple colloid adenomatous goiters and in toxic adenomas over a period of years is not significant. In our group of 1782 multiple colloid adenomas removed between 1926 and 1936, only 11 cases of malignancy were encountered, to give an incidence of approximately 0.5 per cent.

Table 4 gives the results of treatment after operation followed by postoperative x ray treatment

This study of thyroid cancer has been made in an attempt further to correlate the clinical and histologic aspects of the disease

Operation followed by x ray treatment, at present, represents the best approach to treatment. Radioactive iodine will, we hope not only give valuable information regarding the disease but aid in its treatment

TUMORS OF THE THYMUS

ROBERT S LONG AND FRANK N ALLAN

TUMORS of the thymus are rarely found at postmortem examination and even more rarely noted in the course of clinical examination. The occurrence of 41 instances of thymus in 6,000 necropsies at the Yale School of Medicine, apparently only 5 were true thymic tumors in 17,000 necropsies at the Bellevue Hospital. The files of the Lahey Clinic contain 6 cases of thymic tumor discovered in the course of some 300,000 clinical examinations, not including infants. No large series of such cases has been reported and, although our group is small, a review of the problems presented serves to illustrate certain points of clinical importance.

REPORT OF CASES

CASE 1—A 29-year-old man came to the clinic on July 22, 1935, with typical symptoms and findings of severe myasthenia gravis which had begun only six weeks before. He made a good response to treatment with prostigmine during the first few days of treatment in the hospital, but on August 1 he aspirated some cereal while eating breakfast. Thereafter his condition rapidly became worse. In spite of the use of prostigmine, ephedrine, potassium chloride and glucose, the myasthenic symptoms progressed. A Drinker respirator was employed because of respiratory paralysis but death occurred on August 4 from bronchopneumonia.

At necropsy the thymus was found to be enlarged, it weighed 40 gm. At the lower pole there was a firm, well encapsulated nodule, 3 by 5 by 6 cm., this was classified as a benign thymoma.

Comment—This case illustrates the association of changes in the thymus with myasthenia gravis. One must suspect that the tumor had been present for some time before the myasthenia gravis developed in view of the short duration of the symptoms.

Reports on the incidence of thymus tumor in myasthenia show wide variation, but in 127 cases reported by various authors in the past five years in which an examination of the thymus was made either at surgical exploration or at necropsy, a tumor was found in approximately one fourth (28) of the cases. The tumor was malignant in 5 cases, in the remainder it was assumed to be benign thymoma.

CASE 2—A man 26 years of age, came to the clinic on December 18, 1942, with severe symptoms of myasthenia gravis which had appeared one month before. On March 16, 1941 he had been examined elsewhere because of "general malaise and fatigue." Roentgenograms of the chest revealed a mass in the upper mediastinum which was thought to be either an aneurysm or a lymphoma. On the basis of the suspicion of lymphoma, x ray treatment was given, but with no

effect. He was examined for military service on September 24, 1942, and was rejected because a roentgenogram of the chest again showed the mass present in the mediastinum. Its nature was not determined. From fluoroscopy and x-ray films made at the Lahey Clinic it was our conclusion that he had an aneurysm rather than a tumor.

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gated later at another hospital. On December 8, 1945, an operation was undertaken there because it was thought that the mass in the mediastinum might be a tumor of the thymus rather than an aneurysm. This diagnosis proved to be correct and a benign thymoma was removed. The patient died of respiratory paralysis on December 12, 1945.

Comment—In the previous case it was suspected that the thymic tumor had been present for a time before the development of myasthenia gravis. In this case, although the nature of the mediastinal growth was not recognized, the tumor was definitely known to be present.

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a thymus tumor can scarcely be the sole cause.

CASE 3—A 28-year-old woman came to the clinic September 24, 1934, complaining of loss of weight, nervousness, dyspnea, palpitation, and a poor appetite for about four months. She had also noted a mass in the front of the neck.

Examination showed slight enlargement of the thyroid, a slight stare with exophthalmos, dullness to percussion, and diminished breath sounds in the right mid lung field. The basal metabolic rate was +35. Roentgenologic examination of the chest showed the greater portion of the right lung to be obscured by a large mass which apparently arose from the mediastinum and extended to the lateral chest wall.

In preparation for biopsy of the mediastinal mass $\frac{3}{32}$ grain of dilaudid was given. There was a severe reaction in the form of respiratory depression and cyanosis. She was given prolonged artificial respiration and then placed in an oxygen tent. Death occurred three days later and was attributed to pulmonary obstruction.

At necropsy a large, slightly nodular tumor mass was found extending from the superior mediastinum anteriorly and laterally to the right diaphragm. The pathologic diagnosis was malignant thymoma.

Comment—This case illustrates the consequences of local extension of a malignant thymoma. It emphasizes the precarious condition of patients with a tumor in this location. The occurrence of mild hyperthyroidism was considered coincidental.

CASE 4—A 10-year-old schoolboy came to the clinic on September 28, 1942, with symptoms of a raspy cough, difficulty in breathing, and a feeling of tightness in the chest, which had appeared one week before. He had been aware of a swelling of the lower anterior neck for about five weeks. The symptoms rapidly became serious; they were aggravated by exercise and excitement.

Physical examination revealed a mass in the lower neck which extended into the thorax and dullness to percussion over the upper anterior mid portion of the chest. The venous pressure in the antecubital vein was 300 mm of water, the circulation time with calcium gluconate was thirteen seconds. Roentgenograms of the chest showed a large mass in the superior mediastinum, sharply demarcated but with a lobulated outline, it extended from the superior mediastinum to the diaphragm and compressed the lower trachea.

The patient was anesthetized with sodium pentothal in preparation for a biopsy of the mass in the neck. He had been breathing with great difficulty,

of the tumor

At necropsy a huge, creamy yellow mass was found in the superior mediastinum. It weighed 550 gm. A furrow in the center divided it incompletely into two large lobes and smaller irregular lobules extended upward into the neck as far as the hyoid bone. On microscopic examination it was noted that the architecture was entirely that of the cortex of the thymus, there was no medullary zone. The pathologic diagnosis was malignant thymoma.

Comment—This case is another example of a tumor of the thymus which caused compression of the trachea and bronchi, producing respiratory symptoms. In this case the obstruction to the air passages was so serious that death ensued following the ordinarily innocuous anesthetization with sodium pentothal.

CASE 5—A 47-year-old woman came to the clinic on September 22, 1938 because of nervousness, fatigue and loss of weight. The symptoms had been present for three years. Examination showed a hard mass extending above the sternum. Roentgenograms showed the suprasternal and substernal mass causing displacement of the trachea to the left in the lower cervical region. The basal metabolic rate was +2.

Operation was performed on September 24, 1938. The thyroid gland was found to be normal. The tumor mass was adherent to the surrounding structures.

Deep x ray therapy was given. Three small pulmonary metastatic lesions shown by the roentgenogram of the chest apparently disappeared under treatment, but new lesions later appeared in the lung fields and were quite widespread by the time the patient was last seen here on June 12, 1939. After some initial improvement her condition slowly but steadily deteriorated in spite of treatment. She died on March 14, 1940.

Comment—This case illustrates the discovery of a thymic tumor on ordinary physical examination in the absence of any local symptoms which might indicate its presence.

CASE 6—A 22-year-old male student was found to have a mediastinal tumor on a routine x ray of the chest made in anticipation of military service. He had no symptoms and appeared to be in good health. The film showed a round

soft tissue density 4 cm. in vertical height and projecting 4 cm. to the left of the midline in the superior mediastinum at the level of the clavicle. By fluoroscopy, the mass was seen to move with deglutition and with forced respiratory movement. There was no displacement of the trachea or other structures.

Operation was performed on June 30, 1943, by Dr. H. D. Adams. A finger-like projection of the thymus was found extending from the lower pole of the thyroid down to the arch of the aorta. Only this portion of the thymus was removed. The patient made an uneventful recovery. The pathologic diagnosis was hyperplasia of the thymus.

According to a report received by mail in February 1947, roentgenograms of the chest made in 1945 showed recurrence of the mediastinal mass. There were no symptoms. The patient said that he had continued to enjoy good health.

Comment—This case illustrates the finding of an enlarged thymus on routine roentgenologic examination of the chest, without any local or other symptoms.

DIAGNOSIS

As illustrated by these cases, the presence of a tumor of the thymus may be considered when there is myasthenia gravis, and it may be strongly suspected when there are symptoms due to a growth in the superior mediastinum. It may be possible to feel the growth if it extends above the sternum, but roentgenologic examination is essential for diagnosis in view of the normal location of the thymus within the superior mediastinum. Finally, a routine roentgenogram of the chest may reveal a growth in the absence of either local or general symptoms.

To determine the nature of a mass in this location by fluoroscopy or films of the chest is not an easy matter, as indicated by the experience in Case 2. A tumor of the thymus must be differentiated especially from substernal goiter, aneurysm, lymphoma and dermoid cyst.

PATHOLOGY

Ewing stated that "no group of tumors has more successfully resisted attempts at interpretation and classification than those of the thymus." For practical clinical purposes, the following descriptive terms have been commonly adopted in differentiating the various morphologic changes in the thymus.

Hyperplasia of the thymus is said to exist when the organ is larger and heavier than the average. It may occur at any age. The hyperplastic organ continues to show grossly and microscopically the same features as the normal thymus. The diagnosis of hyperplasia rests entirely on gross characteristics rather than on any specific microscopic changes.

According to Hammar, the normal thymus weighs from 7 to 50 gm., averaging 26 to 29 gm. from infancy to age 20. After 20, the weight varies from 2 to 52, the average varying from 21 gm. in the early twenties to 14 gm. after the age of 55. When the weight of the thymus

is compared to the weight of the body as a whole, it appears that there is no sudden decrease in the thymus with maturity. There is rather a steady decrease in the relative weight of the thymus from 0.45 per cent of the body weight at birth to 0.07 per cent at ages 11 to 15, 0.04 per cent at 16 to 20, 0.03 per cent in early adult life and 0.02 per cent after middle age. Many illnesses cause atrophy of the thymus as well as other lymphoid tissue so that at necropsy, the thymus is often only one third of the average normal weight.

Thymoma is a term introduced by Grandhomme in 1900. This should be applied only to a new growth or tumor which arises from, or is made up of, thymic tissue. It may be classified as benign or malignant, depending upon either gross or microscopic changes. *Benign thymoma* is an encapsulated tumor mass made up of either

Malignant thymoma is a tumor mass made up of malignant cells of thymic origin with evidence of invasion of the capsule or adjacent tissues and with or without distant metastasis. On microscopic examination of tissue in certain cases it may be readily apparent that the cells are malignant. It is usually very difficult to determine their exact origin and, without clinical information or gross biopsy or necropsy findings as to the source of the material, it may be impossible in some cases. On the other hand, the examination of biopsy material may lead simply to a diagnosis of thymoma by the pathologist and only the clinician may be able to say whether there is invasion of adjacent organs or parts and distant metastasis from the evidence he obtains at operation, by roentgenologic or by other examination. In nearly all cases reported, including the present series, the local enlargement, invasion, and nearby metastasis of the malignant thymomas constituted their most serious characteristics.

In the 6 cases reported, 1 was classified as an example of hyperplasia, 2 of benign thymoma and 3 of malignant thymoma (except for 1 benign thymoma removed at another hospital, the pathologic reports were made by Shields Warren). The malignant tumors showed two main cell types in the microscopic picture, one, a small lymphocytic type of cell with a small nucleus and dense chromatin, and the other, a larger, "clear" cell, spheroid or polyhedral in shape, with acidophilic cytoplasm and a large clear nucleus with one or more nucleoli, resembling an epithelial cell. Mitotic figures were frequent in 1 case, infrequent in the other 2. Abortive forms of Hassall's corpuscles were present in 2 cases. The presence of Hassall's corpuscles and epithelial elements marks the thymus origin of a tumor and distinguishes it from one of lymphoid origin. It is helpful, but not essential, for both to be present in order to make the diagnosis.

THE THYMUS IN INFANCY

The presence of an enlarged thymus in infants and young children was viewed with much concern in past years. In some cases an apparent enlargement was discovered during a search for the cause of respiratory symptoms such as stridor, "crowing," or cough. In other cases it was sought for routinely before operation in the belief that an enlarged thymus was the cause of some cases of otherwise unexplained sudden death during anesthesia and operations such as tonsillectomy. The discussion of "status lymphaticus" or "status thymico-lymphaticus" now seems to be a closed issue, according to Farber and others there is no good evidence that such an entity exists or is the cause of "sudden death" in any case.

According to Hare, of our x ray department, many instances of

can be made to disappear simply by straightening or extending the child's neck and dorsal spine before taking the roentgenogram. This extends the very flexible mediastinum of the young child and brings the thymus into the midline position. When the upper spine is partially flexed, the mediastinal structures project out toward the pleural cavity and may give a false impression of enlargement.

Even the apparent enlargement which still shows on the chest film of a young child regardless of position almost always disappears spontaneously in time and rarely is the true cause of respiratory or other symptoms. Croft and others however have pointed out that a tumor or extreme enlargement of the thymus may produce respiratory symptoms at any age.

TREATMENT

If one were to judge by this group of cases one would conclude that the treatment of thymus tumor is hopeless. In every one of the 5 cases with actual neoplasm a fatality occurred. In the single case in which the growth proved to be hyperplasia of the organ resection was followed by recurrence. Yet there is reason to believe that treatment in our future cases can be made more effective.

In 3 cases the fatality was caused by malignant disease of the thymus and in 2 it was due to myasthenia gravis which had advanced beyond response to medication. These represent grave problems but hope of some measure of success in meeting them may be achieved in regard to both by earlier diagnosis and application of improved surgical technique.

Roentgen therapy was employed in 1 of the cases of malignant thymoma. It brought about temporary benefit but did not prevent fatal termination. In 1 of the cases of benign thymoma roentgen treatment given elsewhere before the development of myasthenia

gravis was ineffective. Apparently radition therapy is of limited value when enlargement of the thymus is caused by tumor. Intensive radiotherapy has ameliorated the symptoms in some cases but the results are at best palliative (Andrus and Heuer).

In regard to surgical treatment it is possible to maintain hope of improvement in the future. Following the leadership of Blalock, thymectomy has been undertaken in recent years in many cases of myasthenia gravis with and without thymoma. In a series of 8 cases in which operation was performed by Ralph Adams of this clinic there was one fatality. The results in regard to myasthenia gravis in a total of 129 cases reported by Blalock, Hardyman and Bradshaw, Clagett and Eaton, Keynes, Viets and Schwartz, and Adams were as follows: essentially well 17, considerably improved 24, moderately improved 27, and slightly improved 21. The others were unimproved, unclassified or dead. It must be admitted that when myasthenic symptoms have once appeared removal of the thymus, whether presumably normal, hyperplastic or with tumor, has not brought about actual cure even though in many cases there is amelioration of the disorder. It is possible that early removal of a tumor of the thymus might prevent the subsequent development of myasthenia gravis. Thymectomy could then be done by the present day technic with minimal risk.

The surgical removal of a benign thymic tumor might well prevent the occurrence of malignancy in this organ at a later date. It is certainly not possible to predict which of these tumors may be or may become malignant. Early removal of a thymic tumor before it is accompanied by any symptoms should therefore eliminate the hazard of malignancy as well as possibly avert the development of myasthenia gravis. The surgical technic now in use should also permit complete extirpation of the thymus and make impossible return of a benign hyperplastic growth.

SURGICAL TECHNIC

The operative procedure employed by Ralph Adams has been described as follows. An incision is made longitudinally from the isthmus of the thyroid downward over the mid sternum and then laterally to the sternal margin. The suprasternal notch is entered and a forefinger passed beneath the sternum. The sternum is split longitudinally in the midline from the suprasternal notch down to the third intercostal space by use of the Lebsche sternum knife, and then carried laterally to the sternal margin. A self retaining retractor is placed to hold the two margins of the split sternum apart. By dissection the mediastinal pleura of each hemithorax is displaced laterally thus exposing the intrathoracic portion of the thymus gland. The gland is also exposed in the neck up to the inferior thyroid artery. Each lobe is removed separately by dissecting it away from the in-

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According to Hare, of our x-ray department, many instances of apparent enlargement of the thymus have probably been solely the result of faulty positioning of the infant or child when taking the roentgenogram. It has been shown that an apparently enlarged thymus can be made to disappear simply by straightening or extending the child's neck and dorsal spine before taking the roentgenogram. This extends the very flexible mediastinum of the young child and brings the thymus into the midline position. When the upper spine is partially flexed, the mediastinal structures project out toward the pleural cavity and may give a false impression of enlargement.

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MALIGNANT GROWTHS OF THE NASOPHARYNX WITH PARTICULAR EMPHASIS ON THEIR FREQUENCY, SYMPTOMATOLOGY AND DIAGNOSES

WALTER B. HOOVER

THE nasopharynx is the occasional site of primary malignant growths. During a ten-year period from 1934 to 1944 an average of 2.6 cases of nasopharyngeal malignancy were diagnosed each year, which means that for each case of malignant disease of the nasopharynx, 13,000 or more patients are seen.

Erk Godtfredsen* estimated that one case occurred in 181,250 persons per year. At this rate as many as 675 new cases might occur in the United States each year. Thus, a large percentage of physicians will not see or recognize a case of malignant neoplasm of the nasopharynx in the course of several years of their practice.

Since an occasional case is seen by the occasional practitioner, he is unlikely to become alarmed about the patient's symptoms until they are quite annoying to the patient, or he is not likely to become concerned unless they have existed for a considerable time. This is especially true when the patient complains of a stuffy nose, nasal discharge, or decreased hearing. If earache, severe pain, enlarged glands, masses in the neck, or a paralysis of one of the cranial nerves are present, however, the patient may himself seek consultation, or he may be referred to a consultant in the field of surgery, neurology, ophthalmology, rhinology, otology, or radiology. Therefore, it is likely that only a very few physicians will have a wide experience in the diagnosis and treatment of nasopharyngeal malignancies.

SYMPTOMATOLOGY

A malignant tumor may be present for a considerable time, remaining asymptomatic until it has increased in size sufficiently to produce nasal obstruction or until a portion of the tumor erodes or becomes necrotic and bleeds. In many instances, the primary tumor, however, does not become large enough to obstruct the nasopharynx and, also, in a number of cases the tumor does not ulcerate or erode and it may not be recognized even though the area in which the tumor is located is well visualized. These small tumors, however, may invade deeply, compressing the eustachian tube and producing symptoms referable to the ear. They may erode the bones at the base of the skull and may extend for great distances in the bone. The first symptom produced may be pain from involvement of a sensory nerve as it makes

* Godtfredsen, Erk. Ophthalmologic and neurologic symptoms of malignant nasopharyngeal tumors. *Acta Psychiat. et Neurol., Suppl.* 34, 323 pp., 1944.

nominate vein, the pericardium and pulmonary artery upon which it lies posteriorly, and the pleura with which it is immediately in contact laterally. The scattered small vessels entering the thymus gland from the mediastinum are divided separately and ligated. The neck and anterior mediastinum are searched for any aberrant thymic tissue.

CONCLUSION

The discovery of a mediastinal tumor which might originate in the thymus should lead to positive action on the part of the physician. If it proves to be a benign thymoma it may be removed without undue risk. If the tumor proves to be a malignant thymoma, surgical removal may or may not be possible, but in any event the pathologic nature of the tumor can be identified and subsequent roentgen or other treatment properly administered. A reasonably accurate prognosis can also be given.

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period of some four weeks before I realized that the abnormal tissue of the nasopharynx might be a malignancy. Biopsy proved that the abnormal tissues were of malignant character.

Metastases.—The first sign of an asymptomatic nasopharyngeal malignancy which is noted by the patient may be enlargement of cervical nodes. The most frequent location is under the sternomastoid muscle near or at the level of the angle of the jaw, yet these nodes do occur as low as the clavicle and in the posterior triangle of the neck. In two instances multiple metastases occurred, involving the lungs and bone. Any organ of the body, however, may be the site of metastatic invasion.

Neurologic Symptoms or Symptoms Due to Direct Extension of the Growth in the Base of the Skull and in the Orbit.—Loss of function of the sensory cranial nerves and paralysis of the motor cranial nerves take place by direct extension of the tumor which erodes the bones at the base of the skull and may compress or invade the nerves in its path.

The body of the sphenoid, the medial portion of both the greater occiput, and the petrous tip of the
The destruction of the bone about
is quite common when pressure on
the third division of the fifth nerve may produce severe pain. Also, the tumor may reach the dura and extend under it for a considerable distance without penetrating the dura. It may penetrate, and in this manner, the cavernous sinus area may be infiltrated, and the sixth cranial, the first division of the fifth, and in the more extensive cases, the third and fourth nerves are affected. Even the second division of the fifth nerve may be involved in the extension in the area of the sphenoid maxillary fossa and foramen rotunda. The growth may extend into the nose, into the paranasal sinuses and into the orbit. In the orbit it may produce paralysis by infiltration of the muscles or of the nerves, and the orbit itself may be so infiltrated and edematous that exophthalmos results. Direct extension also takes place in the pterygoid area and may extend to the mastoid, producing seventh nerve paralysis. The tumor may extend backward or metastasize about the jugular foramen producing paralysis of the ninth, tenth, eleventh and twelfth nerves.

DIAGNOSIS

The definite diagnosis of malignant tumor of the nasopharynx is made by microscopic examination of tissue removed from the tumor,

explained nodular enlargement in the neck or pharynx, metastatic malignancy in the neck, or unexplained cervical or pharyngeal

its exit through the base of the skull or paralysis of one of the cranial nerves may result from compression or invasion of the nerve by the tumor. Again these tumors may remain asymptomatic in the nasopharynx and metastasize to the glands of the neck which may attain considerable size before the patient views them with sufficient alarm to cause him to seek advice concerning them.

Thus, the symptomatology of malignant tumors of the nasopharynx is varied and may be divided into a number of groups according to the early symptoms produced that is nasal aural neurologic symptoms from metastatic lesions and those from enlargement or direct extension of the tumor.

As the disease advances one individual may present symptoms in any or all of these groups.

Nasal Symptoms—Nasal obstruction with difficulty in breathing through the nose, loss of nasal resonance of the voice and the unusual accumulation of nasal secretion and nasal discharge is typical of nasal obstruction produced from any cause with the exception that it may be more constant and progressive in cases of malignant tumors. Secondary to the nasal obstruction there is a dry mouth from oral breathing, unpleasant pressure on swallowing and headache.

Nasal bleeding of a brisk character may occur from necrosis and erosion of the tumor but it is unusual. With considerable blood loss secondary anemia follows. In many cases the bleeding may be evi-

decomposition and chronic ulceration of the tumor mass.

Aural Symptoms—The earliest aural symptom is a feeling of fullness in the region of the ear or a decrease in hearing, that is the symptoms of tubal obstruction. Tumors which have their origin about the eustachian orifice or in the fossa of Rosenmüller are prone to produce these symptoms. These tumors may be so inconspicuous that they may be overlooked by even quite competent otologists and rhinologists. As the tumor increases in size the eustachian obstruction becomes more complete, fluid may collect in the middle ear and lead to repeated paracentesis with aspiration or inflations without the otologists recognizing the presence of a tumor. Secondary infection may occur which may further confuse the otologist and obscure the picture so that mastoid operations have been done in some cases. In addition to deafness a feeling of fullness in the ear, discharge, tinnitus and pain may be present to a marked degree.

One particular case came under my observation at the time of an acute upper respiratory infection, the patient complaining of earache and a discharging ear. On examination he was found to have marked inflammation of the tissues of the nasopharynx. I treated the patient for his acute upper respiratory infection and his ear infection for a

pathologists in the classification of malignant tumors of the nasopharynx but it can safely be said that most of the tumors are poorly differentiated and are sensitive to radiation therapy that is they are anaplastic carcinomas or sarcomas. The diagnoses shown in Table 1 have been made from biopsy specimens obtained from these tumors. For a complete bibliography and discussion of this subject the reader is referred to the work of Erik Godtfredsen.

TREATMENT

The treatment of all malignant tumors of the nasopharynx with the exception of the fibrosarcoma was deep radiation therapy. In the one case of fibrosarcoma the patient was treated surgically. The patient a boy 15 years of age has been well for seven years and had three years of active service in the Navy. In all cases in which radiation therapy was given marked alleviation followed. In 3 of the cases an apparent cure of five years or more was obtained that is they were without symptoms and without visible evidence of tumor.

Treatment with x rays is very promising and especially if the diagnosis can be made early and full lethal tumor doses are delivered to the tumor area.

SUMMARY

Malignant tumors of the nasopharynx are comparatively rare and the symptoms are varied so that a clear clinical picture is not presented to the practitioner. In order to make the diagnosis the physician must be cancer minded and demand careful examination of the nasopharynx. Biopsy of suspicious areas must be carried out when cervical malignancy is unexplained when cranial nerve lesions are obscure when ear symptoms and symptoms of nasal obstruction such as bleeding are present. The lesions of this area are anaplastic and radiosensitive.

The condition of the patient with nasopharyngeal malignancy is not hopeless. Radiation treatment produces marked improvement in practically all cases that is alleviation of symptoms and prolongation of life while a small percentage of cures is obtained.

malignancy may be secondary to malignant disease of the nasopharynx and that progressive nasal or nasopharyngeal symptoms may be produced by nasopharyngeal malignancy. The physician must not be satisfied until the nasopharynx is properly visualized by mirror, by nasopharyngoscope and if necessary, under anesthesia, with retraction of the palate and a biopsy specimen taken of any suspicious tissue. In regard to performing the biopsy it is necessary, as in lesions elsewhere, to get the tissue from the area of tumor, that is, deeply enough to take tumor tissue. A tumor may extend under fairly normal mucous membrane and the superficial tissue conceal it, whereas a deeper specimen would reveal its presence. The greater percentages, however, are quite superficial and specimens are easy to obtain.

An erroneous diagnosis is often made before the true diagnosis is determined. For instance, on three occasions the general surgeon has removed metastatic glands and radiation therapy was given to the cervical region without realizing that the primary lesion was in the

TABLE 1
DIAGNOSES OF MALIGNANT TUMORS OF THE NASOPHARYNX
MADE FROM BIOPSY SPECIMENS

Epidermoid carcinoma	Grades II and III
	Ungraded
	Unclassified
Transitional cell carcinoma	
Carcinoma simplex	
Lympho-epithelioma	
Lymphosarcoma	
Malignant lymphoma	
Fibrosarcoma (1 case)	

nasopharynx. Likewise in 2 cases, sinus and septum operations have been done without the rhinologist's realizing that the nasopharyngeal tumor was the true source of the patient's difficulty. The otologist on two occasions had gone so far as to do mastoid operations and others have done repeated paracenteses and repeated inflations not realizing that the nasopharyngeal tumor was the etiologic factor producing the symptoms.

The roentgenologic study of the base of the skull is a valuable aid in the diagnosis, since in 30 per cent of our cases there was destruction of the bones at the base of the skull. The mento occipital position has been most useful in revealing the bones adjoining the nasopharyngeal area. It is our belief that the greatest number of mistakes in diagnosis and treatment has resulted from incomplete examination of the nasopharynx. In only 3 of 26 patients seen in the past ten years has the lesion been difficult to recognize on visualization of the nasopharynx.

There has been some disagreement and confusion on the part of

the esophagus. It is nearly always intermittent at first but generally progresses until difficulty in swallowing is constantly present. It may be described as a vague tightness, a queer feeling on swallowing, food sticking in the throat or a lump in the chest, and frequently leads to an erroneous diagnosis of globus hystericus. Regurgitation and epigastric or substernal pain frequently are present. The latter is usually intermittent at first but progresses until it is more or less continuous. It is most often related to the ingestion of food and thus is falsely diagnosed as secondary to gastric ulcer. Cough, hiccup, dyspnea, bringing up blood, and weight loss may occur at various stages in the course of the disease. Hoarseness is a frequent symptom and may be the result of either laryngitis from the constant overflow of secretions into the larynx or of paralysis of the vocal cords. Hoarseness secondary to paralysis of the vocal cords almost always indicates extra esophageal extension of the neoplasm.

The symptoms enumerated are not characteristic of pulmonary or esophageal malignant disease and are frequently associated with other organic or functional disease of these organs. It is this fact that permits carcinomas of the lung or esophagus all too often to reach an inoperable stage before a thorough investigation is instituted and the correct diagnosis established. What then, are the diagnostic measures available today which will enable us to establish the correct diagnosis when the clinical history and physical findings are suggestive of pulmonary or esophageal disease?

ROENTGENOGRAPHIC EXAMINATION

The first and most important aid to a presumptive diagnosis of malignant disease is the roentgenologic examination of the chest or esophagus. Although not infallible, this is the simplest diagnostic procedure at our command and must be considered the most reliable of those procedures which lead to a presumptive diagnosis of malignant disease of the lung or esophagus. The roentgenologic examination should not be confined to a single flat plate of the chest or esophagus but should include careful fluoroscopy as well as special views in instances of questionable disease.

Moersch, in a discussion of the diagnostic aspects of bronchogenic carcinoma, stated that Kirklin has divided the roentgen findings of carcinoma of the lung into three groups. The first group consists of those cases in which the tumor casts a distinct shadow, constituting the predominant roentgenographic finding. In the second group, the tumor cannot be delineated but its secondary manifestations, such as bronchial obstruction, secondary malignant lymphatic spread, pulmonary metastases, and pleural effusion, are of the third group and may completely obscure the underlying tumor. Holinger et al. believe the classical roentgen findings of bronchogenic car-

METHODS OF ESTABLISHING A DIAGNOSIS OF MALIGNANT DISEASE OF THE BRONCHUS AND ESOPHAGUS

FRANK D LATHROP

THE management of pulmonary and esophageal malignant disease has advanced considerably since Graham performed the first successful pneumonectomy in 1933 for bronchogenic carcinoma. Sufficient numbers of successful cases of pneumonectomy and partial resection of the esophagus have been reported during the past decade to establish definitely that surgical therapy is more successful in eradicating these diseases than any other form of treatment. Many problems still remain to be solved, however, and the greatest of these is the

course of the disease and the necessity for adequate investigation of symptoms when patients do present themselves for diagnosis will do much to afford a solution and can be facilitated by close cooperation between clinician, roentgenologist and endoscopist.

Bronchogenic and esophageal carcinomas occur predominantly in the Caucasian male. The one notable exception is posterocoidal carcinoma, which is seen most frequently in the female. These diseases occur most commonly in patients past 40 years of age and the greatest incidence is approximately in the sixth decade. Bronchogenic carcinoma is fifth and carcinoma of the esophagus seventh in frequency in types of carcinoma occurring in males. During 1940, 5,556 deaths were reported to be caused by the former while the latter accounted for 2,804 deaths.² Such figures indicate that pulmonary and esophageal malignant disease is not infrequent in occurrence and emphasize the need for familiarity with methods of diagnosis which will enable the proper diagnosis to be established.

Unfortunately, there is no typical train of symptoms characteristic of either of these pathologic processes. Bronchogenic carcinomas produce symptoms similar to those of any inflammatory disease of the lung and depend essentially on the size and location of the tumor. Cough is the predominating symptom followed by chest pain, dyspnea, hemoptysis, expectoration and weight loss. Hemoptysis occasionally confuses the picture in that it may erroneously be attributed to pulmonary tuberculosis and thus delay the institution of proper treatment. Hoarseness occurs infrequently but is an important symptom when secondary to vocal cord paralysis since it is indicative of spread to the mediastinum and, therefore, that the lesion is inoperable. Dysphagia is the most common single complaint of carcinoma of

so than that obtained by inspection of the remainder of the tracheobronchial tree or esophagus. The bronchoscopic picture may reveal the presence of a tracheoesophageal fistula or evidence of extension of the malignant process to the mediastinum as depicted by paralysis of the inferior laryngeal nerves, intraluminal bulging of the posterior membranous wall of the trachea or bronchus, fixation and blunting of the usually sharp and mobile division of the trachea anatomically known as the carina or by compression of the esophagus. Extension to the mediastinum by a carcinoma of the esophagus is manifested by immobility of the normally freely movable esophagus and by paralysis of the inferior laryngeal nerves. Furthermore, determination of the character, extent and degree of esophageal obstruction present is helpful in determining the nature of the palliative treatment to be instituted in the event the lesion is inoperable. Ascertainment of whether or not a pulmonary or esophageal carcinoma has extended to the mediastinum is extremely important for when mediastinal extension has occurred the carcinoma is no longer in an operable stage.

Bronchoscopy and esophagoscopy while simple and important diagnostic methods are not without some element of risk. A number of instances of severe reaction to the anesthetic agent used when endoscopy is performed under local anesthesia has been reported. Aneurysmal dilatation of the aortic arch is usually considered a contraindication to the performance of such procedures. The great vessels of the thorax are closely related to the tracheobronchial tree and esophagus and may be perforated by injudicious use of the biopsy forceps. An esophageal perforation may result occasionally secondary to biopsy of a necrotic esophageal growth and results in mediastinitis. Mediastinitis may also occur secondary to an esophageal laceration incurred by the passage of an esophagoscope when sharp "lipping" of the anterior borders of the cervical vertebral bodies is present. In patients past 40 years of age it is well to obtain a lateral roentgen projection of the cervical spine in order to determine whether or not such "lipping" is present and if present whether or not it is of sufficient degree to contraindicate esophagoscopy. In spite of these elements of risk, however, these diagnostic procedures should be employed almost without exception in all cases in which the history, the clinical findings and the roentgenographic examination are sug-

OTHER DIAGNOSTIC AIDS

Although a positive diagnosis of malignancy can be established in almost all cases of esophageal carcinoma by esophagoscopy and biopsy, a positive diagnosis is not possible in a considerable number of cases of bronchogenic carcinoma by bronchoscopic examination.

cinoma are those produced by varying degrees of bronchial obstruction, while small, nonobstructive tumors may be manifested by a localized area of pneumonitis or give rise to no roentgen changes.

Roentgen examination of the esophagus with the aid of a barium meal provides a simple and readily available means of making a presumptive diagnosis of carcinoma of the esophagus in the majority of cases. A carcinoma at the entrance to the esophagus, however, may be obscured by ossified laryngeal cartilages or by the speed with which the barium is propelled past this point by the hypopharyngeal muscles. Carcinoma of the cardia may also be difficult to demonstrate in the roentgen film. Fluoroscopy of the esophagus while the patient is ingesting a barium meal is indispensable in the examination of these regions and no roentgenologic examination of the esophagus is complete without fluoroscopic study.

Although roentgenologic examination of the chest and esophagus permit a presumptive diagnosis of pulmonary or esophageal malignant disease in a high percentage of instances, it must be pointed out that if such an examination is negative it does not preclude the existence of neoplastic disease of these organs. It is important, therefore, when the clinical history is suggestive of malignant disease and the physical and roentgenologic examinations are negative, that further diagnostic procedures be instigated.

ENDOSCOPY

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or esophagus suspected of harboring a neoplasm. It is the most accurate method of establishing an early positive diagnosis of bronchial or esophageal malignant disease. An adequate bronchoscopy or esophagoscopy has been performed only when a satisfactory biopsy

of the nature of the pathologic process observed at endoscopy. Occasionally, when a malignant process is surrounded by a zone of granulation tissue, difficulty may be encountered in obtaining a biopsy specimen revealing the true nature of the lesion. In such instances, if the history, clinical findings and roentgenologic examination indicate the presence of a neoplasm the endoscopic examination should be repeated and further biopsy material obtained until a final diagnosis can be established.

Bronchoscopy and esophagoscopy aside from their importance as diagnostic procedures, are invaluable aids in determining whether or not a carcinoma of the lung or esophagus is operable. Information relative to the location, intraluminal extent and character of the lesion is important in assessing the operability of the tumor, but no more

so than that obtained by inspection of the remainder of the tracheo bronchial tree or esophagus. The bronchoscopic picture may reveal the presence of a tracheo esophageal fistula or evidence of extension of the malignant process to the mediastinum as depicted by paralysis of the inferior laryngeal nerves, intraluminal bulging of the posterior membranous wall of the trachea or bronchus fixation and blunting of the usually sharp and mobile division of the trachea anatomically known as the *carina* or by compression of the esophagus. Extension to the mediastinum by a carcinoma of the esophagus is manifested by immobility of the normally freely movable esophagus and by paralysis of the inferior laryngeal nerves. Furthermore, determination of the character, extent and degree of esophageal obstruction present is helpful in determining the nature of the palliative treatment to be instituted in the event the lesion is inoperable. Ascertainment of whether or not a pulmonary or esophageal carcinoma has extended to the mediastinum is extremely important for when mediastinal extension has occurred, the carcinoma is no longer in an operable stage.

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This is understandable since in from 30 to 40 per cent of the cases the neoplasm is situated in the superior lobe or periphery of the lung and is beyond the range of vision of the bronchologist

may occur secondary to granulation tissue, tuberculosis, foreign bodies and other affections of the bronchus

Clerf and Herbut have recently advocated *careful examination of smears of bronchial secretions* obtained at bronchoscopy for cancer cells. They reported that a cytologic diagnosis of carcinoma was made in 47 of 57 proved cases of bronchogenic carcinoma by examination of the stained smears of bronchial secretions obtained during the bronchoscopic examination, while the diagnosis was established by bronchoscopy or bronchoscopic biopsy in 39. Of greater importance is the fact that they were able to make a cytologic diagnosis in 12 cases in which the bronchoscopic examination was entirely negative. Their report would indicate that this diagnostic aid is a valuable adjunct to the establishment of a diagnosis of pulmonary malignant disease.

When it is impossible to establish a positive diagnosis of bronchogenic or esophageal carcinoma by biopsy or laboratory procedures and the history, physical examination and roentgenographic examination point to a presumptive diagnosis of malignancy, *exploratory thoracotomy* is justified. The technic of thoracic surgery has been perfected to such a degree that there is little more risk in performing a thoracotomy than there is in performing a laparotomy. In this way a positive diagnosis may be established after all other methods have failed at a time when the lesion is amenable to surgery. Early exploratory thoracotomy when all other measures have failed, will establish the correct diagnosis and will prevent a number of cases of suspected pulmonary and esophageal malignant disease from becoming inoperable.

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PRIMARY TUMORS OF THE ESOPHAGUS

HERBERT D ADAMS

SYMPTOMS of esophageal obstruction may be caused by a wide variety of lesions such as stricture, esophagitis, diverticulum or tumor. Obstruction by tumor may be caused by an extension of the growth and secondary involvement of the esophagus from a tumor in some other organ in close relationship to it or the lesion may be primary in the esophagus itself. The most frequent form of the latter is carcinoma, although rarely a benign tumor is encountered.

Because of their rarity and their amenability to cure, the benign tumors are of considerable interest. In the literature there has been reported a small number of a rather great variety of benign tumors. We have encountered esophagenic cysts, polyps, fibroma and leiomyoma, which represent most of the common types. Generally speaking, a benign tumor may be suspected if the presenting symptom of difficulty in swallowing has been of prolonged duration, usually several months, and is progressing. The diagnosis is made by studies of the esophagus, by roentgenologic examination of the lumen of the esophagus.

to determine whether an ulceration or involvement of the mucosa is present. If there is any suspicious appearance of the mucosa in this region or the tumor is an intraluminal lesion, a biopsy specimen, of course, must be obtained to rule out carcinoma. In general, however, if the mucosa is intact, biopsy should not be performed in benign intramural lesions to avoid secondary infection complicating its removal later.

In the benign lesions, the diagnosis is established primarily by roentgenologic examination (Fig 225). Once this is done, surgical removal is advisable. This is a relatively simple and safe procedure and a cure can be expected. The patients should be given large doses of penicillin intramuscularly for a few days before operation to clear up any secondary infection and then operated on by the transthoracic route. Wide exposure by a posterolateral incision is made (Fig 226), the mediastinum opened and the tumor and esophagus mobilized in this region. The intramural tumors may be dissected out from the muscular layers, carefully preserving intact the mucosa. If the tumor is pedunculated or mainly intraluminal the base must be excised, thereby opening the mucosa. All layers must be carefully reapproximated with fine interrupted silk sutures. The operative field in the mediastinum is then sprayed with 100,000 units of penicillin solution and the mediastinal pleura closed. Another 100,000 units of penicillin solution is sprayed into the pleural cavity, and the lung reexpanded leaving an intercostal catheter for temporary suction drainage. Large

doses of penicillin intramuscularly are administered for a week or more following operation. The intake by mouth is limited strictly during the first few days and then the intake is gradually increased over the following ten day period. I have not found it necessary by this management to do preliminary gastrostomy or to have an indwelling Levine tube in the esophagus postoperatively.

Primary malignant tumors of the esophagus, that is carcinoma, occur frequently and can now be resected at all levels, with the exception



Fig. 225—Benign leiomyoma of the midthoracic esophagus

of the superior thoracic strait, and the continuity of the gastrointestinal tract reestablished. This latter fact has made it more reasonable to resect a greater number of these lesions, many of course, purely palliative resections, as in stomach lesions. The operability and resectability have, therefore, increased considerably in the last few years. The principal symptom of this lesion is steadily progressive difficulty in swallowing, progressing to absolute dysphagia for solid foods in a matter of a few months. By this time, however, most of these lesions are inoperable and it, therefore, is essential that an early diagnosis be

are to come to surgery at a favorable stage. Any abnormality by roentgenologic examination (Fig 227) or persistence or progression of the clinical symptoms must be checked further by esophagoscopy and biopsy. Once the diagnosis is established a decision must be

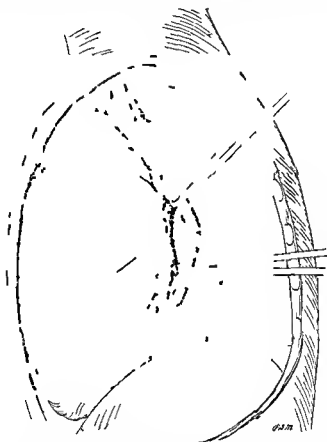


Fig 226—Diagram to show the exposure obtained in removing the benign tumor shown in Figure 225

made as to whether or not a one or two stage operation is indicated based on the nutritional and general state of the patient. If he is in

given intramuscularly for a few days and then a transthoracic resection carried out if technically possible

A wide posterolateral approach is made, and the esophagus and lesion are mobilized unless the tumor is inoperable because of its extension or glandular involvement. If the tumor is resectable, the diaphragm is paralyzed by removing a section of the phrenic nerve as it crosses the pericardium, opened and the entire stomach mobilized down to the antrum or pylorus if necessary, preserving at least one of the distal arteries. The esophagus is then cut across at the junction with the stomach and this opening in the stomach closed. The esoph-



Fig 227—Carcinoma of the midthoracic esophagus

agus is purposely not cut across above the lesion at this stage since it is utilized to maintain traction until the top of the fundus of the stomach is anchored firmly with a row of well placed interrupted silk sutures to the posterior wall of the esophagus well above the lesion. The esophagus is then transected at this level and a meticulous two layer anastomosis made using interrupted silk sutures throughout. In its upper third the esophagus and often the lesion itself must be carefully mobilized from behind the arch of the aorta (Fig 228) and the anastomosis must then be made above and anterior to the arch. Ex

treme care in walling off and protecting the mediastinal tissues and pleura is most important. Intramediastinal and intrapleural penicillin is administered at closure and a catheter for suction is introduced to aid the rapid reexpansion of the lung. Massive doses of penicillin for seven to ten days after operation and limited and progressing intake are essential in the postoperative management.



Fig. 228.—Diagram to show the mobilization and anastomosis of the stomach above and anterior to the arch of the aorta in high resections of the esophagus.

By this plan of surgical and postoperative management, the majority of these patients will survive their operation without complications or residual infections. If a residual infection does develop, however, the anastomosis, no matter how carefully done, will break down, establishing an esophagopleural fistula which ultimately will cause the patient's rapid decline and death. Early diagnosis and improved surgical technique and management are giving steadily improving results.

DIAGNOSIS AND TREATMENT OF LUNG TUMORS

RALPH ADAMS

Our experience at the present time indicates that operative removal of lung tumors offers the most hopeful therapy available. Radiation therapy, either x rays or radium, has been completely unsuccessful as a curative procedure, although providing worth while temporary palliation in occasional tumors of anaplastic cell type or malignant pleural effusion. Its use should be restricted to patients in whom the tumor is inoperable or those being treated with radiation as a supplementary postoperative measure.

The resectability of a malignant tumor of the lung furnishes only a tentative indication of the curability prospect. We have carried out wide resections of small and apparently early carcinomas of the lung and seen the patients die of recurrence or metastasis within two years. We have also resected large pulmonary carcinomas, which were attended by weight loss, bronchial obstruction and infection in expectation of securing nothing more than short term palliation and seen the patients alive and working for as long as four years afterward. Similar observations have been made in respect to carcinomas of other organs, particularly the stomach. The slowly growing lesion of low grade malignancy may have jeopardized the patient's life less in a period of months than the highly malignant lesion in a period of weeks. Such divergent or paradoxical behavior makes exploratory thoracotomy advisable in most cases of possible resectability, and free of demonstrable extension or metastasis. On the other hand we have no patient with undifferentiated or oat cell carcinoma alive for as long as two years after resection including some lesions which were present for a very short time, as judged by size and symptoms, and we now question the wisdom of resection in cases with such a diagnosis established by bronchoscopic biopsy. Except for the fact that the diagnosis of cell type from the bronchoscopic biopsy has some times had to be

examined the resectability for undifferentiated

course, in general, is so little altered thereby. It is these classes of lung carcinoma that show the best palliative response to radiation treatment, and survival time is equal to or better than that following resection in these two specified groups. Epidermoid carcinoma and adenocarcinoma are best treated by resection.

The early diagnosis of pulmonary carcinoma will continue to provide the most rational basis for successful treatment, at least until and unless discoveries are made which advance our meager funda-

mental knowledge of malignant disease. This is a point repeated in almost every article which appears in the literature on malignant tumors and yet the ratio of operable to inoperable carcinoma of the lung for the past ten years has remained almost constant at 1 to 3. One sometimes wonders if all who can be reached by the written record already know the value of this point, and by their actions achieve the early diagnoses that are made, while a larger segment of the profession and the public constantly fail to be reached or forced into action by the available knowledge which would allow an early diagnosis in a higher percentage of cases. If the public could be taught to consult a physician for any cough of more than two weeks' duration, for any hemoptysis, at the onset of sputum production, or at the appearance of chest pain of any degree, the medical profession would then be in position to make an early diagnosis in over 90 per cent of cases of pulmonary disease. This percentage estimate is based on a survey of our own patients with pulmonary disease whom we have seen within two weeks of the appearance of the above enumerated symptoms. It is worthy of note, however, that in nearly one tenth of these cases the pulmonary lesions were judged to be of considerably longer duration than the symptomatology would indicate, and therefore were not early diagnoses. We believe that a roentgenogram of the chest at yearly intervals for every citizen is wise, and that such a program should be instituted as soon as feasible.

The specialist in thoracic disease not infrequently encounters cases of advanced disease in which there have been one or more of the following points of professional divergence from proper diagnostic procedure. First, the patient's thoracic complaints are treated symptomatically, without radiologic investigation. In other words, the cause is not sought. Second, a single film is taken, without fluoroscopy or supplementary views, and the cause may be missed. Third, an abnormal shadow is seen, and a decision reached to watch it for a period of weeks or months to see what will happen. This course of inaction, without corollary study or qualified consultative advice, is procrastination that may cause tragic delay.

The symptoms of carcinoma of the lung are largely related to bronchial encroachment, ulceration, obstruction or involvement of the pleura. In the statistical order of frequency, they are cough 93+ per cent, pain 54 per cent, sputum 53 per cent, hemoptysis 44 per cent, dyspnea 17 per cent, and wheeze 14 per cent.

Physical signs of a lung tumor alone are rarely detectable. The signs, as they appear secondarily to tumor invasion, are a unilateral wheeze of partial bronchial occlusion, diminished breath sounds peripheral to bronchial encroachment, dullness and rales over a collapsed or infected lobe or lung, a flat percussion note and distant breath sounds caused by pleural effusion. Occasionally, the trachea is palpably displaced toward the side of pulmonary collapse. Signs

of extension or metastasis should also be sought. These include atony of a vocal cord from invasion of the recurrent laryngeal nerve, enlarged nodes in the supraclavicular fossae or axillae, or liver enlargement.

By means of careful fluoroscopy and properly exposed films, a competent radiologist can make or state as a positive suspicion a diagnosis of lung tumor in over 95 per cent of cases subsequently proved to have that diagnosis. No other method approaches the accuracy of the well trained radiologist in this diagnostic selectivity. Among the important criteria for diagnosis are the shadow of a tumor mass, localized emphysema on films taken in expiration, shadows caused by collapse of the pulmonary parenchyma, paradoxical movement or fixation of the diaphragm, mediastinal shift and pleural effusion.

In about 50 per cent of cases of lung tumor, bronchoscopy will allow one to see or confirm the presence of the lesion in or around the primary, lobar, divisional or segmental bronchi. Peripherally situated tumors causing no bronchial obstruction can rarely be seen bronchoscopically.

If there is pleural effusion, the fluid should be withdrawn, centrifuged and the sediment stained and searched for malignant tumor cells. The sputum should be similarly examined. Effusion is an indication of inoperability if bloody and containing cancer cells.

Nonmalignant tumors of the lung are encountered in about one twentieth the frequency of carcinoma, and most of these are bronchial adenomas. The symptoms, signs and radiologic features are similar to those of carcinoma in that they cause a cough, sporadic hemoptysis, lead to bronchial occlusion, pulmonary infection and atelectasis. They are seen most frequently in young women. Although the lung may be of long duration,

a striking feature in the diagnosis, and in one third of the cases bronchoscopic removal alone suffices as treatment. Because of a pronounced tendency to extraluminal growth and bronchial compression, approximately two-thirds eventually require resection.

RESULTS OF SURGICAL TREATMENT

Patients operated on subsequent to December 31, 1945 were excluded to permit examination of results more than one year after operation.

Fifty six patients have been treated by either lobectomy or pneumonectomy for carcinoma. There were 8 hospital deaths. Six of these occurred in the first 17 cases, and only 2 hospital deaths occurred in the last consecutive 39 resections. In other words, details of technical management have been perfected until operative mortality is low.

enough to allow analysis of survival rate on the basis of control of the carcinoma. Fifteen of the 56 patients are now alive and well without evidence of recurrence, 5 for more than a year after operation, 3 for more than two years, 2 for more than three years, 1 for more than four years, 3 for more than five years, and 1 for ten years.

In the nonmalignant group of 8 resections, all patients are alive and well.

BENIGN MEDIASTINAL TUMORS

A Report of Six Cases with Analysis of Diagnostic Criteria and Advocacy of Surgical Removal

ESTHER SILVEUS AND RALPH ADAMS

Six cases are presented in this report to illustrate the four types of mediastinal tumor most frequently encountered in clinical practice. These lesions are not rare but they are infrequent, and are believed in many instances to be congenital anomalies or developmental arrests. Hare, in a review of 288 mediastinal tumors of all types, including those caused by metastases from extramediastinal primary growths, found 11 of the congenital type, namely, dermoid cyst, teratoma and bronchial cyst. The mediastinal growth seen more often than any other type is the neurofibroma. These congenital tumors and the neurofibroma (and ganglioneuroma) exhibit several closely similar clinical features. They are round or ovoid in shape, they originate in the mediastinum close to the midline. If and as they grow larger they may extend laterally against the lung, or anteriorly or posteriorly against the heart and thoracic wall, with associated pressure phenomena.

There are, however, differences of behavior of importance both diagnostically and prognostically. The congenital cyst, being fluid filled and located in the anterior or mid mediastinum where it is subjected to equal pressure from all sides, is round in shape. It may show slight change in configuration with change in the patient's position during fluoroscopic observation. The rate of growth of the benign cyst is slow and erosion of surrounding structures does not occur because of the malleability of its thin walls and fluid contents. Sometimes one wall of the cyst is molded to fit the contour of the aortic arch or surface of an auncle, but such a structure is never molded to fit the contour of the cyst. Such cysts occasionally enlarge rapidly by accumulation of fluid within them from infection, or from malignant degeneration, and these are the reasons why the benign mediastinal cyst is potentially dangerous. Its removal ordinarily is a simple technical procedure (Case 3), but may be rendered exceedingly difficult, or impossible, if perforation into a bronchus or the chest wall (Case 2), inflammatory fusion with the hilar structures or pericardium (Case 1), or malignant extension has occurred.

The neurofibroma, being a solid tumor and located in the posterior mediastinum, is subjected to unequal pressure from the rigid verte

ter in which it usually lies. As a tumor of neurogenic origin, it often grows inward along intercostal nerve pathways to invade the neural foramina or spinal canal.

Not unlike the root of a growing tree adjacent to a stone, this solid, slowly growing tumor is able to spread the ribs or erode their pedicles and surfaces by virtue of long-continued pressure. These facts of position and exerted pressure provide two points of value in the differential diagnosis of such tumors. Here again, the removal of a small neurofibroma is neither difficult nor dangerous (Case 4), but the long neglected tumor may grow until paralysis or irreversible structural deformity (Case 5) has resulted and the condition of the patient has become incurable (Case 6). For these reasons it is, in general, wise to make a diagnosis and to decide upon definitive treatment that will effect a cure if the tumor can be completely excised.

The congenital cyst may be discovered in any age group from infancy onward. The ages in the 3 cases reported here are 34, 35 and 37 years. In a series of 185 cases reported in the literature and reviewed by Hedblom, the youngest was a still born infant and the eldest 62 years. In that series, many of the patients had vague ill-defined or no symptoms, and the diagnosis of mediastinal tumor was made by roentgenologic or postmortem examination. Of those patients presenting symptoms, the onset was insidious in three fourths and abrupt in one fourth. The symptoms may be present from a few months to many years. In the 3 cases here reported, the duration of symptoms was six months, two years and twelve years, respectively, before the patient came to operation. The initial symptoms were substernal pressure sensations, productive cough and swelling of the neck, and pain in the anterior left chest and arm. Initial complaints in other patients have been variable, including dyspnea, pleurisy, enlargement of the neck, and cough productive of blood, pus and hair. The most frequent physical finding is dulness to percussion over the site of the tumor, but it should be emphasized that abnormal physical signs have not been elicited in most of the patients with mediastinal cysts coming under our observation.

In the three cases of neurofibromas reported, backache was the chief complaint in Case 4, and the tumor was discovered on a routine chest roentgenogram made at the patient's place of employment. In Case 5 the chief complaint was that of intermittent pain of several years' duration, with a recent sensation of constant pressure. By physical examination, no blood pressure reading was obtainable in the left arm, from obliteration of the subclavian artery by pressure. In Case 6 the chief complaint was increasing deformity of the thorax and lumbar spine, with no associated pain. There was some exertional dyspnea. From this enumeration of the symptoms and signs to be expected in these two types of mediastinal tumors, it is apparent that a diagnosis can rarely be made from the clinical findings alone.

A diagnosis of mediastinal tumor can be made promptly and accurately by adequate roentgenologic examination, although a statement concerning the exact type of tumor is not always possible. From the increasing use of mass chest roentgenography of large segments of the general population, one may expect that an increasing number of small or asymptomatic mediastinal tumors will be discovered. In a series of 288 cases of dermoid cyst and teratoma reviewed by Laipply, 28, or 11.4 per cent, were malignant. The operative mortality for such lesions if the surgical procedure is done at an early stage, should be under 1 per cent. It would thus appear that excision upon establishment of the diagnosis should be the advocated policy of treatment.

In the roentgenologic study, it is important to include fluoroscopy with barium visualization of the esophagus, postero anterior stereoscopic films of the chest, a lateral film, and a film to record bony detail. By fluoroscopy, the pulsation which would be transmitted in this type of tumor is distinguished from pulsation in an aneurysm of the aorta. The postero anterior and lateral views enable one to observe the localization of the tumor in the posterior or anterior mediastinum and its position in respect to the right or left pleural cavity. From the film which shows the bony detail, the presence or absence of bony changes in the ribs or vertebrae is determined. Displacement of the esophagus or trachea may be seen both by fluoroscopy and on the films.

The dermoid cyst and the teratoma usually lie in the anterior mediastinum while the bronchial cyst and neurofibroma are located in the mid or posterior mediastinum. All may project into either the right or the left pleural cavity. The dermoid cyst and teratoma may vary in size from 1 cm. to 20 cm. in diameter. They are single, well circumscribed tumors. They frequently contain calcification in the walls, and often well formed portions of teeth and irregular bone spicules are visible within the tumor. Differentiation must be made from echinococcus cyst which exhibits the same type of calcification, but not teeth and bone. In Cases 1 and 2 there was calcification and in Case 2 a well formed tooth. Tumors which are located posteriorly may cause displacement of the esophagus and aorta if situated in the middle and upper thirds of the mediastinum the trachea frequently is displaced. In Case 3 the descending aorta and esophagus were both displaced to the left and there was widening of the bifurcation of the trachea. Case 4 which is that of a neurofibroma caused no displacement of the trachea and esophagus but did show definite bone changes including spreading of the ribs and pressure erosion of the rib surfaces and pedicles. In Case 5 the tumor was large and located in the midportion of the superior mediastinum and the superior portion of the left pleural cavity and extended into the left neck. The trachea was displaced and there were changes in the

second and third ribs just beyond the vertebral border. In Case 6 the roentgenograms showed pressure erosion on the upper dorsal spine, cysts in the ribs and generalized decalcification. The esophagus and trachea were both displaced forward by a large mass, but they were not invaded by it.

The operation in each of these cases was done under gas oxygen ether intratracheal anesthesia. A posterolateral, anterolateral, or mid sternal thoracotomy incision was used in accordance with the location of the tumor and the probability of best exposure for each case separately. At the completion of each operation, the thoracic wound was closed tightly about an intercostal catheter placed into the pleural cavity for drainage, after reexpansion of the lung. The catheter was kept on suction drainage (15 cm negative pressure measured in water) until serous pleural effusion ceased. The catheter usually was removed on the third or fourth postoperative day. Fine silk was used as the ligature and suture material. The patients were allowed out of bed about the eighth postoperative day and discharged from the hospital about the fourteenth postoperative day.

Case 1—A man of 34 years was admitted August 8, 1945, complaining of discomfort in the left arm and chest and a sensation of substernal pressure of two years duration. Six weeks before admission he suffered briefly from sharp pain across the anterior chest on one occasion. There was no history of cough, hemoptysis, palpitation or dysphagia.

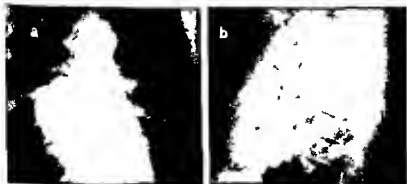


Fig 229—Case 1. Dermoid cyst. *a*, Postero-anterior view of chest showing well circumscribed, partially calcified mass in right hilar area. *b*, Lateral view showing anterior position of tumor.

On physical examination there were diminished breath sounds over the fourth to the sixth ribs anteriorly on the right, accompanied by diminished resonance. The voice sounds were low pitched or deadened as though heard through encapsulated fluid. The blood Hinton test was negative and the blood count determination was within normal limits.

Roentgenologic examination (Fig 229) revealed a well circumscribed mass in the right hilar area as shown in the postero-anterior film of the chest, it was

anterior in the lateral films. There was calcification in the superior wall of the mass with no definite structure such as a tooth visualized. The mass measured 7 cm. in diameter.

At operation a cyst about 7 cm. in diameter was removed. It was densely adherent posteriorly to the pericardium, pulmonary artery, aorta and innominate vein. It was also adherent to the pleura of the right upper lobe. Hair and calcium as well as thick tenacious liquid material were contained within the cyst.

The diagnosis was dermoid cyst of the anterior mediastinum extending into the right pleural space. The patient was cured.

CASE 2—A woman of 35 years was admitted September 29, 1944, complaining of frequent colds with productive cough and four draining sinuses in the sternum. In 1932 this patient had spontaneous onset of pleurisy in the right chest, followed a few weeks later by the appearance of a mass in the supra-sternal notch which ruptured spontaneously. Sinuses gradually appeared down



Fig. 230—Case 2. Teratoma. *a*, Postero-anterior view of chest showing well circumscribed, partially calcified mass to right of midline in upper third of mediastinum. On original film a well formed tooth could be distinguished. *b*, Lateral view showing anterior position of tumor.

the course of the sternum. An operation with drainage was done elsewhere and the sinuses remained closed until six months before entry when they reopened, and thenceforth drained continuously and copiously a watery fluid which was irritating to the skin.

Laboratory studies showed a sedimentation rate of 71 mm. in an hour, a leukocyte count of 13,100 and an erythrocyte count of 4,840,000. Sputum examination and smears made from the draining sinus secretions were negative for acid fast bacilli.

Roentgenograms (Fig. 230) showed a well circumscribed soft tissue mass in the anterior mediastinum lying in the upper third and to the right of the midline. Calcification was present, which had the appearance of a well formed tooth.

At operation, a large infected cyst, measuring 7.5 by 6 cm. was removed. It

was connected to the anterior chest wall by draining sinuses. The capsule was adherent posteriorly to the pleura pericardium and superior vena cava.

The microscopic diagnosis was teratoma with ectopic pancreas and secondary infection. The bacteriologic diagnosis was *Staphylococcus aureus* and *Streptococcus viridans*.

The postoperative course has been excellent except for persistent slight oozing from the midsternum caused by a small focus of osteomyelitis. The patient is working, feels well, and has not yet consented to have the small sequestrum removed.

CASE 3—A man of 37 years was admitted April 30, 1945, complaining of pain in the left chest and arm occurring at night of six months' duration. There was no relationship of the pain to exertion, eating, or other bodily function.

Roentgenologic study (Fig. 231) showed a rounded soft tissue mass in the posterior mediastinum, lying to the right of the midline and displacing the de-

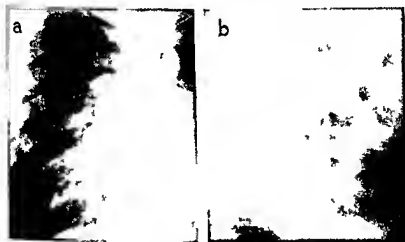


Fig. 231—Case 3. Bronchial cyst. *a*, Postero-anterior view of chest showing rounded soft tissue mass extending to right of midline in lower third of mediastinum. *b*, Lateral view showing posterior position.

scending aorta and the esophagus to the left. There was widening of the bifurcation of the trachea. Transmitted pulsation was visualized in the tumor.

At operation a cyst 7 cm in diameter was removed. It was adherent on the right to the right auricle and to the wall of the esophagus. The diagnosis was bronchial cyst.

The patient recovered and was relieved.

CASE 4—A woman of 30 years was admitted January 16, 1945, with a complaint of backache since childhood. Otherwise she had always been in good health. In 1926, or nineteen years previously, a chest roentgenogram had shown "something wrong." In 1944, several months before admission, a routine roentgenogram of the chest at her place of employment had shown a cyst in the chest. Three years previously she had small cysts removed from the back and face.

On physical examination, there was swelling medial to the right scapula, with

locally increased tactile fremitus, tenderness and slightly decreased breath sounds. Moistness in the skin of the right hand was increased in comparison with the left hand.

Roentgenologic examination (Fig 232) confirmed the presence of a soft tissue mass in the right upper thorax posteriorly. There was evidence of separation of the third and fourth ribs and of an erosive process involving the body and facets of the third dorsal vertebra on the right side. The esophagus and trachea were not displaced from their normal positions.



Fig 232—Case 4. Neurofibroma. *a* Anteroposterior view showing soft tissue mass to right in upper dorsal region and separation of third and fourth ribs posteriorly. Destruction of pedicle of third thoracic vertebra can be seen on right. *b* Lateral view showing posterior position of tumor.

At operation the soft tissue mass was found to lie in the costovertebral gutter between the third and fourth ribs just to the right of the vertebral column. An extension of the solid tumor entered the vertebral column but not the dura. The mass was smooth and firm and measured 4 by 6.5 by 9 cm. The diagnosis was neurofibroma.

The patient recovered and was relieved of her complaint.

CASE 5—A woman of 28 years was admitted June 13, 1940, complaining of a sensation of pressure and dull pain in the left upper thorax of several years' duration. At first the pain lasted only a few seconds. At the time of admission there was pain and a feeling of pressure every day. There had been one small hemoptysis. Following a roentgenologic examination previous to admission a diagnosis of neurofibroma was made.

By physical examination the blood pressure reading was not obtainable in the left arm and the left radial pulse was absent. There was dullness and absence of breath sounds in the left thoracic apex. Blood studies were within normal limits. Prominence of the second rib anteriorly on the left, caused by a small chondroma, was noted.

Roentgenograms (Fig 233) showed a soft tissue mass approximately 10 cm in the greatest diameter extending from the apex to the level of the sixth interspace posteriorly. The trachea was displaced to the right. There was erosion of the second and third ribs just beyond the vertebral border.

At operation, an irregularly lobulated solid tumor 10 cm in diameter was removed. The lower margin lay over the arch of the aorta and was adherent to the posterior and lateral pleura in several places. The tumor surrounded and displaced the left subclavian artery. It extended through the thoracic inlet and behind the brachial plexus. The upper margin of the tumor lay opposite the fifth

cervical vertebra and the posterior surface was intimately connected to the cervical sympathetic ganglia. The subclavian artery had to be divided before the tumor could be removed. The diagnosis was ganglioneuroma.



Fig 233—Case 5 Ganglioneuroma. *a*, Postero-anterior view of chest showing large soft tissue mass in upper thorax on left. *b*, Lateral view showing posterior position of tumor.

Postoperatively, the patient's preoperative complaints disappeared slowly and she is now symptomatically well. There is persistent ptosis and pupillary constriction of the left eye (Horner's syndrome). The left arm and hand are warm and dry and fully functional, but there are no palpable pulsations at the wrist.

July 16, 1945, with a complaint of
umbilical spine of two years' dura
a nocturnal nonproductive cough,

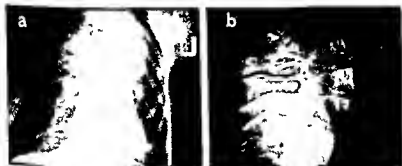


Fig 234—Case 6 Neurofibromatosis. *a*, Postero-anterior view of chest showing soft tissue mass in upper thorax, scoliosis of spine to left and cystic changes in ribs on right. *b*, Decalcification of bones, scoliosis and distortion of ribs on right can be seen.

there were no leg pains and no gastrointestinal symptoms. She was not able to run and play vigorously, but otherwise was not short of breath. She had been treated conservatively for eighteen months after a diagnosis of a tumor of the spine was made.

locally increased tactile fremitus, tenderness and slightly decreased breath sounds. Moistness in the skin of the right hand was increased in comparison with the left hand.

Roentgenologic examination (Fig 232) confirmed the presence of a soft tissue mass in the right upper thorax posteriorly. There was evidence of separation of the third and fourth ribs and of an erosive process involving the body and facets of the third dorsal vertebra on the right side. The esophagus and trachea were not displaced from their normal positions.



Fig 232—Case 4 Neurofibroma. *a* Anteroposterior view showing soft tissue mass to right in upper dorsal region and separation of third and fourth ribs posteriorly. Destruction of pedicle of third thoracic vertebra can be seen on right. *b* Lateral view showing posterior position of tumor.

At operation the soft tissue mass was found to lie in the costovertebral gutter between the third and fourth ribs just to the right of the vertebral column. An extension of the solid tumor entered the vertebral column but not the dura. The mass was smooth and firm and measured 4 by 6.5 by 9 cm. The diagnosis was neurofibroma.

The patient recovered and was relieved of her complaint.

CASE 5—A woman of 28 years was admitted June 13, 1946, complaining of a sensation of pressure and dull pain in the left upper thorax of several years duration. At first the pain lasted only a few seconds. At the time of admission there was pain and a feeling of pressure every day. There had been one small hemoptysis. Following a roentgenologic examination previous to admission a diagnosis of neurofibroma was made.

By physical examination, the blood pressure reading was not obtainable in the left arm and the left radial pulse was absent. There were dullness and absence of breath sounds in the left thoracic apex. Blood studies were within normal limits. Prominence of the second rib anteriorly on the left caused by a small chondroma was noted.

Roentgenograms (Fig 233) showed a soft tissue mass approximately 10 cm in the greatest diameter extending from the apex to the level of the sixth interspace posteriorly. The trachea was displaced to the right. There was erosion of the second and third ribs just beyond the vertebral border.

At operation, an irregularly lobulated solid tumor 10 cm in diameter was removed. The lower margin lay over the arch of the aorta and was adherent to the posterior and lateral pleura in several places. The tumor surrounded and displaced the left subclavian artery. It extended through the thoracic inlet and behind the brachial plexus. The upper margin of the tumor lay opposite the fifth

CLINICAL PROBLEM OF PHEOCHROMOCYTOMA

ELMER C. BARTELS AND NORMAN M. WALL

ALTHOUGH a suggested characteristic pattern of attack has been described for sympathetic tumors of the adrenal gland the problem of diagnosis remains difficult. All patients do not manifest typical symptoms and at times patients remain asymptomatic until a hypertensive crisis is incited during the course of an elective operation or at the time of removal of a previously unidentified suprarenal tumor. The need for a keen awareness of this syndrome on the part of the internist and anesthesiologist is emphasized in the 4 cases to be reported. Since specific diagnostic tests are now available, the condition can be diagnosed if at all considered.

REPORT OF CASES

CASE 1.—A woman, 23 years of age, was first seen in February, 1946. Her only complaint was that of peculiar recurring attacks, five to six times daily, during the previous three years. The attacks lasted ten to fifteen minutes and consisted of weakness, severe throbbing headache, dyspnea, palpitation, epigastric and substernal pain, nausea and vomiting, unsteadiness, and blotchiness of the skin. The attacks usually came after eating and at times were relieved by vomiting or sneezing. Between the attacks she was perfectly well. During the

all pounds
The pulse rate was 120 and blood pressure was 102 mm systolic and 94 mm diastolic. Shortly after admission to the hospital she had one of her typical attacks during which the blood pressure was found to be 180 mm of mercury systolic and 120 mm diastolic which led to the suspicion of an adrenal tumor.

Routine urine and blood studies were normal. The gastric acids, serum calcium and phosphorus, and nonprotein nitrogen were all within normal limits. The fasting blood sugar was 100 mg per 100 cc, during attacks it was 147, 156 and 166 mg per 100 cc. The serum potassium during an attack was 21.3 mg per 100 cc. An intravenous pyelogram was reported to show a depression of the left kidney consistent with a space-occupying mass in the left upper quadrant of the abdomen.

A histamine test (intravenous injection of 0.5 mg of histamine) according to the method of Roth and Kvale⁶ was positive, a hypertensive reaction with reproduction of a typical attack resulted, with a systolic pressure of 200 mm and diastolic pressure of 140 mm. A similar hypertensive reaction followed the subcutaneous injection of 25 mg of mechohl.

The history of recurring episodes with the demonstration of significant hypertension during a typical attack, the inciting of a typical attack with histamine given intravenously and mechohl given subcutaneously and roentgenologic findings of a mass in the left adrenal region pointed conclusively to the diagnosis of a left sided pheochromocytoma.

On physical examination there was a prominent right scalenus anticus muscle and marked dorsal scoliosis and kyphosis, with the concavity toward the right side

Roentgenologic study (Fig 234) confirmed the spinal deformity as just stated. In addition, there was pressure erosion of the upper dorsal spine cysts and thinning in the ribs with erosion and generalized decalcification. There was a mass behind the trachea, displacing the trachea and esophagus forward but not invading either one.

Calcium and phosphorus studies were done and these excluded a diagnosis of parathyroid disease.

At operation, there was an extensive, soft invasive tumor extending laterally from the vertebral column and outward between the intercostal spaces. The tumor had flattened the ribs until they were paper thin and had grown under the pleura, causing it to present a lobulated surface. The foramina of the vertebral column were widened from pressure necrosis of adjacent bone. The tumor was too extensive for complete removal. The diagnosis was neurofibromatosis.

The child recovered uneventfully from the operative procedure, but has an incurable tumor and may be expected to die eventually from respiratory insufficiency or spinal cord paralysis.

SUMMARY AND CONCLUSIONS

Six cases with the diagnosis proved by operation and pathologic examination are reported as examples of the types of benign mediastinal tumor most often encountered in clinical practice.

Diagnostic features are enumerated and discussed.

Reasons for an advocated policy of early diagnosis and prompt surgical removal are stated.

Methods used in the conduct of the surgical procedure are summarized.

Most benign mediastinal tumors may be recognized when small and in a favorable stage for safe surgical removal by means of a program of annual chest radiography of the population.

These tumors are potentially dangerous, as they may enlarge rapidly, become infected, perforate, or destroy normal structures by pressure. Eleven and four tenths per cent are believed to undergo malignant degeneration but which specific tumors will degenerate, perforate or cause irreparable damage by invasion cannot be predicted.

Operative removal is advised.

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CASE 2—A priest, previous year he had lasting about thirty seconds — — — — — 1939 During the previous year he had had attacks of nervousness, each attack lasting about thirty seconds he was standing under tension, as in church, and were associated with palpitation, throbbing in the head and a sense of body tremor Previous examinations had revealed the presence of a fluctuating systolic blood pressure, 150 to 210 mm Because of the elevated blood pressure he had been on a vegetable diet during the previous three months and had lost 25 pounds In 1923, and occasionally afterward, sugar was found in the urine, but only in small amounts

The patient weighed 156 pounds The pulse rate was 80 and the blood pressure 158 mm systolic and 90 mm diastolic He appeared nervous and overactive

The results of laboratory studies were as follows the hemoglobin was 14.8 gm, erythrocytes numbered 4,470,000 and leukocytes 9,350 The Hinton test was negative and the blood sugar 98 mg per 100 cc The urine contained a slight trace of albumin, 0.43 per cent sugar, the specific gravity was 1.026 and the sediment contained a rare leukocyte The roentgenogram of the skull was normal The electrocardiogram showed a rate of 80, auricular premature contraction and a tendency to left axis deviation

It was concluded that the problem was vasomotor in type and since the patient was overworked and extremely tense, the attacks were thought to be functional in origin He was advised to take a period of rest and then return to work on a restricted schedule

The patient was not seen again until three years later at which time he complained of puffiness of the hands and ankles, occurring chiefly in the morning, during the previous nine months At first the swelling was periodic but for three months had been constant During the previous six weeks he had gained 10 pounds in weight The spells of transient weakness had continued and usually followed sneezing His physician had noted that the systolic blood pressure varied from 165 to 210 mm

On physical examination there was definite edema of the hands and ankles The blood pressure was 168 mm systolic and 70 mm diastolic and the pulse rate 92 His weight was 159 pounds

Urinalysis showed 3 plus albumin and 2 per cent sugar, with the sediment containing many hyaline casts The hemoglobin was 104 per cent, erythrocytes numbered 5,240,000 and leukocytes 12,300 The blood nonprotein nitrogen was 26 mg, and sugar 103 mg per 100 cc The total serum protein was 5.9 gm per 100 cc, albumin 3.5 gm, globulin 2.4 gm, and plasma cholesterol 205 mg per 100 cc

The clinical picture at this time suggested a nephrotic syndrome as indicated by albuminuria and reduced blood protein values with normal hemoglobin, erythrocytes and nonprotein nitrogen A dietary factor also was considered as a cause of reduced serum protein value since he had restricted the use of protein over the previous three years He ate meat only once a week and no fish, eggs or dairy products He also had avoided taking salt

Because of hypoproteinemia and edema it was decided to attempt to restore the blood protein with intravenous amino acids Almost immediately after starting the intravenous administration of amigen, severe dyspnea developed, with a cough

During the next few days basilar rales were present in the lungs Follow-

Exploratory operation of the right adrenal area determined that the right adrenal gland was normal. A tumor 8 cm in diameter was then removed from the left adrenal area. During the removal of the tumor a severe hypertensive reaction with circulatory collapse occurred. The tumor weighed 260 gm. the pathologic diagnosis was pheochromocytoma (Fig 235). Pharmacologic studies indicated that 1 gm of the tumor had a pressor activity equivalent to 13 mg of epinephrine base.



Fig 235—Case 1 Photomicrograph showing the typical large irregular hyperchromatic nuclei granules in cytoplasm many of which stain yellow brown with eosin methylene blue method practically clear stroma between cell syncytia, infrequently lined with endothelium ($\times 600$)

The patient's postoperative course was satisfactory. Two weeks after removal of the tumor intravenous histamine and subcutaneous metoprolol failed to produce a hypertensive reaction. Three months after operation the blood pressure was 110 mm. systolic and 78 mm. diastolic, she had gained 4 pounds in weight, had more energy and was working daily. She had not experienced any of the previous attacks.

right kidney to be normal in size, shape and position. The left kidney outline was obscured by intestinal gas.

A diagnosis was made of diabetes mellitus and coronary sclerotic heart disease with angina pectoris. Dietary and insulin treatment was instituted for the diabetes, following which the urine became sugar-free and the abdominal discomfort was relieved, but the substernal discomfort became worse. An electrocardiogram at this time showed a normal rhythm, rate of 100 and inverted T_3 .

Following discharge from the hospital, she reported by mail, every one or two months, that there was a gradual decline in health, with fatigue, loss of strength, palpitation, rapid pulse and substernal pressure on exertion.

On January 30, 1937, she was readmitted to the hospital for study because of daily chest distress typical of angina which was incited by the slightest exertion. Following an anginal attack she would be prostrated for the entire day. During the previous three weeks a tense feeling developed in the left lower quadrant of the abdomen.

On physical examination at this time the blood pressure was 150 to 160 mm systolic and 80 to 84 diastolic. The pulse rate per minute varied between 90 and 100. A large mass was found in the left upper abdomen. An intravenous pyelogram showed this to be a large retroperitoneal mass which had displaced the left kidney downward to the crest of the ilium. The electrocardiogram showed a left axis deviation, inverted T_3 and a deep S_1 .

At operation, a large tumor mass, 13 by 9 by 6 cm, was found attached to the upper pole of the left kidney. Since the kidney was found to be infiltrated by tumor tissue, it was removed with the tumor. Because the patient's condition became so poor, with a rapid pulse and low blood pressure, no attempt was made to examine the right adrenal gland. The pathologic report of the tumor was pheochromocytoma.

The patient was seen five years later. She continued to have substernal pain on exertion. The blood pressure level was 180 to 210 mm systolic and 92 to 110 mm diastolic. The diabetes had become more severe so that 48 units of insulin was required to keep the urine sugar free. Two years later the blood pressure was 194 to 210 mm systolic and 100 mm diastolic and the angina was more severe. The electrocardiogram at this time showed a depression of the S T segment in leads I, II and IV.

CASE 4—A man 52 years of age, was first seen on June 14, 1944. Three years before he had had an upper abdominal exploration, but no information was available as to what was done. His chief complaint was discomfort in the region of a large postoperative ventral hernia which was tender on pressure.

The pulse rate was 80 and the blood pressure 120 mm systolic and 80 mm diastolic. Routine urine and blood studies were normal as were roentgenographic studies of the stomach and colon.

On the sixth day after entering the hospital, surgical repair of the hernia was undertaken. Before induction of spinal anesthesia (18 cc. of 1 per cent pontocaine and 27 cc. of 10 per cent glucose), the blood pressure level was 120 mm systolic and 60 mm diastolic and the pulse rate was 74. Twenty minutes later the systolic blood pressure rose to 200 mm and the diastolic to 130 mm. Ten minutes later while the upper part of the abdomen was being explored, the blood pressure and pulse became imperceptible and pulmonary edema developed. Through an intratracheal tube the bronchia were suctioned and oxygen was administered under pressure. The patient continued in a state of profound cir-

ing administration of a high protein diet, with supplementary powdered amino acids and salt restriction, which was well tolerated, the peripheral edema gradually subsided and he was discharged from the hospital.

Two and a half months later the patient required hospitalization again, showing evidence of myocardial failure. Shortness of breath had started three weeks before and had become progressively worse so that he required two pillows at night for comfort. Edema of the legs had progressed upward to involve the sacral region. The liver was moderately enlarged. The blood pressure reading was 190 mm. systolic and 100 mm. diastolic. For the first time the retina contained many small hemorrhages.

Laboratory studies showed a 4 plus albuminuria with a specific gravity of 1.007. The blood nonprotein nitrogen was 45 mg. and rose gradually to 133 mg. per 100 cc. The total serum protein was 6.2, with the serum albumin 3.4 and globulin 2.8.

Blood sugar determinations varied from 118 to 246 mg. per 100 cc. There were 3,100,000 erythrocytes. A roentgenogram of the chest showed cardiac enlargement (cardiothoracic measurements were 17 to 32.4 cm.), with fluid at the left base. The electrocardiogram revealed a rate of 110, left axis deviation and inverted T₁. Twenty-four hour blood pressure studies ranged between 160 and 200 mm. systolic and 85 to 110 mm. diastolic.

The usual measures for combating myocardial failure, including the administration of diuretics and digitalis, were instituted but the patient grew progressively worse and died suddenly after an attack of severe mid back pain and pulmonary edema.

The diagnosis made before necropsy was Grade III hypertension with myocardial failure, chronic nephritis and mild diabetes mellitus. The diagnosis of intercapillary glomerulosclerosis was also given consideration because of mild diabetes mellitus, hypertension, retinitis, nephritis, anemia and edema. The main finding at necropsy was a firm, well encapsulated tumor of the right adrenal gland, measuring 6.5 by 5 by 3 cm. and weighing 105 gm. On microscopic examination the tumor was found to be a pheochromocytoma. Other findings were bilateral hydrothorax and hypertrophy of the heart (575 gm.). The kidneys were normal in size, with a finely granular surface and on microscopic study marked intimal thickening of the arterioles with some actual calcification was observed.

CASE 3—A woman 59 years of age was first seen in April 1936. During the previous four years she had noted tightness of the upper abdomen which was intermittent at the onset and then became constant. The discomfort was especially noticeable after meals at which time there was associated dyspnea, palpitation and a fluttering sensation in the abdomen. She had recently lost 8 pounds (137 to 131 pounds) in weight. During the previous six months she had also noted dyspnea, substernal pressure and discomfort in the neck and jaws following exertion, which was relieved with rest.

Physical examination revealed that the patient was well developed and well nourished. The pulse rate was 80 and blood pressure level 160 mm. systolic and 100 mm. diastolic. The left kidney was easily palpated but considered normal in size. Except for mild psoriasis, the remainder of the examination was negative.

Urinalysis revealed 0.4 to 1.10 per cent sugar. Blood counts were normal and the Hinton test gave negative results. The blood nonprotein nitrogen was 27 mg. per 100 cc. and blood sugar 235 mg. per 100 cc. Roentgenograms of the stomach, colon and gallbladder were normal. A roentgenogram of the abdomen showed the

right kidney to be normal in size, shape and position. The left kidney outline was obscured by intestinal gas.

A diagnosis was made of diabetes mellitus and coronary sclerotic heart disease with angina pectoris. Dietary and insulin treatment was instituted for the diabetes, following which the urine became sugar free and the abdominal discomfort

electrocardiogram

3

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palpitation, rapid pulse and substernal pressure on exertion.

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On physical examination at this time the blood pressure was 150 to 160 mm systolic and 80 to 84 diastolic. The pulse rate per minute varied between 90 and 100. A large mass was found in the left upper abdomen. An intravenous pyelogram showed this to be a large retroperitoneal mass which had displaced the left kidney downward to the crest of the ilium. The electrocardiogram showed a left axis deviation, inverted T_3 and a deep S_1 .

At operation a large tumor mass 13 by 9 by 6 cm, was found attached to the upper pole of the left kidney. Since the kidney was found to be infiltrated by tumor tissue, it was removed with the tumor. Because the patient's condition became so poor, with a rapid pulse and low blood pressure, no attempt was made to examine the right adrenal gland. The pathologic report of the tumor was pheochromocytoma.

The patient was seen five years later. She continued to have substernal pain on exertion. The blood pressure level was 180 to 210 mm systolic and 92 to 110 mm diastolic. The diabetes had become more severe so that 48 units of insulin was required to keep the urine sugar free. Two years later the blood pressure was 194 to 210 mm systolic and 100 mm diastolic and the angina was more severe. The electrocardiogram at this time showed a depression of the ST segment in leads I, II and IV.

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The pulse rate was 80 and the blood pressure 120 mm systolic and 80 mm diastolic. Routine urine and blood studies were normal as were roentgenographic studies of the stomach and colon.

On the sixth day after entering the hospital, surgical repair of the hernia was undertaken. Before induction of spinal anesthesia (18 cc. of 1 per cent pontocaine and 27 cc. of 10 per cent glucose), the blood pressure level was 120 mm systolic and 60 mm diastolic and the pulse rate was 74. Twenty minutes

Through an intratracheal tube the bronchi were suctioned and oxygen was administered under pressure. The patient continued in a state of profound cir-

TABLE 1
SUMMARY OF CASES

Case	Age in Yrs and Sex	Symptoms	Blood Pressure	Correct Diagnosis (when made)	Remarks
1	23 F	3 yr history of daily attacks lasting 10-15 minutes—weakness throbbing headache dyspnea and palpitation	102/94 During attack 180/120 Rise incited by histamine metabolism	Preoperatively Confirmed at operation	Complete relief of symptoms after operation
2	61 M	1 yr history of 20 recurring attacks lasting 30 seconds to 1 minute of generalized weakness palpitation throbbing in head	158/90 3 yrs later 220/110 sustained	Biopsy at necropsy	Condition unrecognized Progressed to sustained hypertension with cardiac and renal failure
3	59 F	Pain in left upper abdomen Mild dyspnea and palpitation and flitting sensation in abdomen after meals	160/110 After spinal anesthesia, unobtainable	Biopsy post operatively	Mild symptoms—hypertensive reaction precipitated by spinal anesthesia Following operation, progressive hypertension.
4	52 M	None (postoperative abdominal hernia)	120/60 After spinal anesthesia 200/130 and then unobtainable	Biopsy at necropsy	Asymptomatic—hypertensive reaction precipitated by spinal anesthesia Fatal outcome

culatory collapse in spite of intravenous administration of 5 per cent glucose in saline solution, 25 mg of ephedrine, 5 mg of pitressin, 5 cat units of digitalis, $7\frac{1}{2}$ grains of aminophyllin and $\frac{1}{400}$ gram of atropine intravenously. Pulmonary edema increased with cyanosis, and death occurred four hours and twenty minutes after the spinal anesthesia was induced.

Necropsy revealed a well encapsulated tumor, which measured 4 cm in diameter, of the left adrenal gland. Pathologic examination revealed the tumor to be a pheochromocytoma. The other findings were marked pulmonary edema, bilateral hydrothorax, dilatation of the right heart and mucosal hemorrhages throughout the intestine.

COMMENT

These 4 cases show the various possible clinical features (Table 1) of a sympathetic adrenal tumor. The patients may have various symptoms or be entirely without symptoms (Table 2). The first patient had characteristic symptoms of the syndrome and fortunately, the blood pressure was observed during an attack, which led to the correct diagnosis which was confirmed by the production of attacks with histamine and meclohyol.

TABLE 2
CLINICAL TYPES—PHEOCHROMOCYTOMA

A Symptomatic

- 1 Typical Episodic hypertension (Case 1)
- 2 Chronic progressive hypertension (Case 2)
- 3 Mildly symptomatic (Case 3)

B Asymptomatic

- 1 Operation induced hypertension (Case 4)

Case 2 when first seen presented symptoms similar to but much milder than those of Case 1. During the course of the next three years, Grade III hypertension developed with cardiac and renal failure. The episode of acute left ventricular failure which occurred following the intravenous administration of amino acids was most likely a severe hypertensive reaction and had the blood pressure been determined during that time, the correct diagnosis might well have been made. This case suggests that persistent hypertension may develop as the result of renal changes caused by the hypertensive attacks. The kidney changes, which at first are functional, soon become organic.

Case 3 had mild symptoms which in retrospect were suggestive of paroxysmal hypertension. She also had attacks of angina. The adrenal tumor, because of its size, produced discomfort in the left upper part of the abdomen, which led to its discovery. The true nature of the tumor was revealed only by microscopic study. Case 4 gave no history of hypertensive episodes and the operation undertaken was an elective repair of a postoperative ventral hernia.

The correct diagnosis was made in only 1 of the 4 patients. Only Case 1 had typical attacks. Cases 2 and 3 had mild symptoms which

in retrospect would fit the symptoms of this syndrome. Consideration of the possibility in every patient with vasomotor episodes should lead to a higher incidence of correct diagnoses now that helpful diagnostic aids for sympathetic adrenal tumor are available to us.

The sudden rises in blood pressure values with subsequent so called shock which were observed at operation (Cases 1, 3 and 4, Fig. 236) were all quite similar. In Case 1, manipulation of the tumor during its removal incited the hypertensive reaction, but in Cases 3 and 4 hypertension was noted shortly after the administration of spinal anesthetic. The hypertension probably resulted from the drop in blood pressure (Case 3) which follows spinal anesthesia, causing a reaction such as that which follows an injection of mecholyl or histamine. The fall in blood pressure following spinal anesthesia causes a demand for secretion of epinephrine which, in the presence of an adrenal tumor, will

epinephrine is
The serious
state at operation has been attributed by many writers to a state of shock. If shock is defined as a state of peripheral vascular collapse, then in our cases just the opposite mechanism seems to take place. The best explanation of this state of shock is that an excess of circulating epinephrine causes an increase in peripheral resistance which progresses to such a degree as to cause serious left ventricular strain and resulting pulmonary edema. The bronchial fluid which was aspirated in Case 1 at the time of operation during the absence of pulse and blood pressure was definitely blood tinged, similar to that seen in cases of acute left heart failure. The hypertensive reaction with vascular collapse at operation seems analogous to that which would result from placing a clamp on the ascending aorta, causing great cardiac strain.

The treatment or alleviation of such a reaction requires the immediate removal of the adrenal tumor rather than a delayed approach. This is necessary to prevent the further secretion of epinephrine into the circulation and also if a "state of shock" is present the low blood pressure may logically call for further epinephrine. Measures which are used in cases of acute heart failure are necessary such as administration of oxygen and digitalis and perhaps peripheral vasodilating drugs. Many authors^{1, 2, 5, 7, 8} attribute this shock reaction to adrenal lack and, therefore, advise the use of epinephrine. This agent should not be helpful and in the amounts given by some observers may well be harmful.

The shock state with pulmonary edema may continue even after removal of the tumor if the cardiac reserve is insufficient to restore proper circulation. If the tumor is permitted to remain after the collapse takes place, as in Case 4, the cardiac strain may continue with increasing pulmonary edema, and death may result.

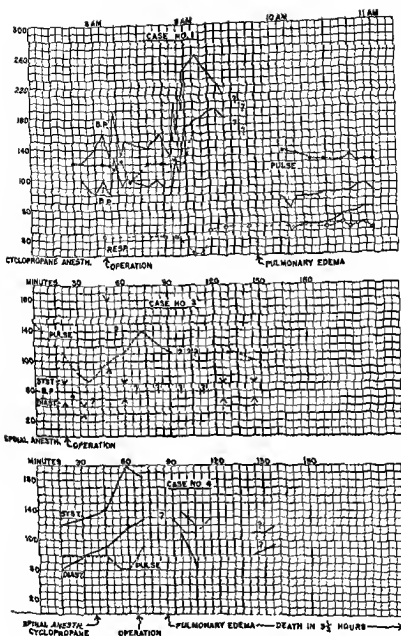


Fig 236.—Blood pressure changes during operation as noted in Cases 1, 3, and 4

nor, with subsequent observed subsequent vascular collapse and pulmonary edema did occur, resulting in death.

The risk of removal of an adrenal sympathetic tumor is great. Of 37 cases reported in the literature, 10 patients died either during or shortly after operation. Our 2 patients survived. If the tumor is removed successfully, complete relief of all symptoms may follow, as in Case 1. Of the 27 reported operative survivals 24 patients were completely well.

SUMMARY

The 4 cases of sympathetic tumor of the adrenal gland here reported have various clinical manifestations of this disease. Since vasomotor symptoms were prevalent in all these cases, one must consider an adrenal tumor in patients presenting these complaints, irrespective of severity of the symptoms. If the correct diagnosis is made as in Case 1 (and this is now possible with newer diagnostic procedures such as histamine and mecholyl), and if the patient's cardiac reserve is sufficient to tolerate the operation with its hypertensive reaction a clinical cure results. If the correct diagnosis is not made fixed hypertension with progressive cardiac and renal failure results (Case 2). If an adrenal tumor is found, as in Case 3, the true nature of the tumor should be determined before operation since the anesthesiologist and surgeon will then be aware of the problem and better able to plan the anesthesia avoiding spinal and proceed with dispatch to remove the tumor. Should an unusual hypertensive reaction be observed by the anesthesiologist during the course of an elective operation as in Case 4 the diagnosis of sympathetic adrenal tumor should be considered and if proven by abdominal exploration, serious consideration should be given to its removal.

The use of epinephrine in the event of a shock state with pulmonary edema during the operation for removal of these adrenal tumors is not judicious since actually the state of shock is best explained as the result of left ventricular heart strain secondary to increased peripheral resistance owing to an excess circulatory epinephrine. Therapy of the condition includes rapid removal of the tumor and the administration of oxygen and digitalis. Recovery from the reaction depends chiefly on the patient's cardiac reserve.

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INDICATIONS FOR SPLENECTOMY

JOHN W. NORCROSS

IN recent years our knowledge of the relationship existing between the spleen and the reticulo endothelial system on the one hand and the bone marrow on the other has been considerably augmented. It is known that the spleen normally exerts an inhibitory action on the hematopoiesis of the bone marrow. There exists a delicate balance between these organs. Under certain circumstances this balance is interrupted and a serious change in hematologic values may occur. The causes for such an interruption are many and are still ill understood. It is believed that tumors, toxic substances of many sorts, certain drugs and some metabolic disturbances play an important role in this regard.

No longer can it be said that there are but two clear-cut medical indications for splenectomy, namely, congenital hemolytic jaundice and idiopathic thrombocytopenic purpura. The list must now include idiopathic neutropenia, selected cases of congestive splenomegaly, primary panhematocytopenia, selected cases of secondary panhematocytopenia and certain cases of acquired hemolytic anemia (Table 1).

TABLE 1

INDICATIONS FOR SPLENECTOMY

- 1 Rupture of the spleen
- 2 Ptosed spleen
- 3 Primary splenic tumors
- 4 Congenital hemolytic jaundice
- 5 Acquired hemolytic jaundice (selected cases)
- 6 Idiopathic thrombocytopenic purpura
- 7 Idiopathic neutropenia
- 8 Primary splenic panhematocytopenia
- 9 Secondary splenic panhematocytopenia (selected cases)
- 10 Congestive splenomegaly (selected cases)

Rupture of the Spleen.—There is no cause to argue the indication for splenectomy when that organ has been injured and is a source of hemorrhage. Such cases are surgical emergencies and demand immediate attention. Rupture may occur immediately following trauma to the spleen or may be delayed for a matter of days or even weeks before the bleeding assumes sufficient proportion to be obvious. Splenic rupture occasionally occurs in fulminating cases of malaria, chronic myelogenous leukemia, typhoid fever, typhus, subacute bacterial endocarditis, infectious mononucleosis and following multiple infarcts from any cause.

Ptosed Spleen.—The spleen, because of occasional elongation of its pedicle, may migrate to any part of the abdomen and may even

be mistaken for a pelvic tumor. Occasionally, such a spleen may become twisted on its pedicle and give rise to an acute surgical emergency. A movable spleen, because of the danger of strangulation, should be removed.

Primary Splenic Tumors.—Rarely, primary tumors may arise in the spleen. They may be malignant as is the case with fibrosarcoma, endothelioma and lymphosarcoma, or they may be benign as in certain angiomatous tumors. Splenectomy is obviously indicated in the malignant tumors if no demonstrable metastatic lesion is present.

Splenectomy should be carried out in the occasional case in which an Echinococcus cyst involves the spleen. Care must be taken to remove it without rupturing the cyst since an anaphylactic reaction will occur if the contents of the cyst come in contact with the peritoneum. Small, multiple cysts of the capsule are benign and of themselves need not be removed, but the occasional large single cyst, either dermoid or hemorrhagic, or of the type that may follow infection, calls for splenectomy. Rarely, congenital polycystic disease involves the spleen but requires splenectomy only if an adverse effect on hematopoiesis can be demonstrated, or if the procedure seems wise from a mechanical point of view.

Congenital Hemolytic Jaundice.—The basic abnormality in this condition probably is a congenital change in the red blood cell, it is small in diameter but thicker than normal. These spherocytes are removed by the reticulo-endothelial system of which the spleen is an important part. These cells show increased fragility in hypotonic saline solution. Their breakdown by the reticulo-endothelial system leads to evidence of increased hemolysis, namely an increased urobilinogen output in the urine and feces and an hyperbilirubinemia with jaundice. The anemia resulting from this destruction causes stimulation of the

In such cases, removal of the spleen stops the greater part of this hemolytic destruction and the whole cycle ceases, although there is no change in the abnormal cells themselves. If care is taken to hunt out and remove any accessory spleen rarely is there any return of anemia or jaundice. Indeed, for some time there is some degree of polycythemia because of the marked hyperplasia of the bone marrow.

Acquired Hemolytic Jaundice.—This may be acute or chronic. Acute hemolytic processes often, but not universally, respond to splenectomy. At times, when the patient's condition is critical enough to forbid splenectomy, ligation of the splenic artery may be life-saving and may be followed at a later and safer time by splenectomy. The scope of this paper does not permit a detailed discussion of the chronic acquired hemolytic anemias. They need detailed individual study and

only in selected cases can splenectomy be advised. Results are uncertain although occasionally spectacular. It should generally be considered the procedure of last resort.

Idiopathic Thrombocytopenic Purpura—Patients suspected of having idiopathic thrombocytopenic purpura require careful study. All known causes of thrombocytopenia must be ruled out, all drug contacts carefully investigated and allergic phenomena considered. The bone marrow must be observed and the presence of a normal or increased number of megakaryocytes established. It is believed that the presence of large numbers of eosinophils in the bone marrow is suggestive of an allergic state and that in such cases operation should not be carried out. If these precautions are strictly observed and splenectomy performed only in those cases in which no cause for thrombocytopenia can be found in which there is no eosinophilic infiltration of the bone marrow, and when the bone marrow studies disclose a normal or increased number of megakaryocytes, results on the whole will be good. Under the best of circumstances however relapses do occur in some cases after splenectomy, sometimes many years later. About 75 per cent of patients who undergo splenectomy for this condition remain permanently cured. The response to splenectomy is immediate and dramatic with a rapid rise of the platelets to or above

is it so essential to be certain that accessory spleens^u are removed at the time of splenectomy as it is in thrombocytopenic purpura because if purpura recurs the uncertainty of finding splenic tissue at operation makes a surgical procedure prohibitively dangerous.

Idiopathic Neutropenia—In recent years this condition has been established as a definite entity and has taken its natural place beside hemolytic anemia and thrombocytopenic purpura. Here also as in the case of thrombocytopenia, known causes for neutropenia, drug or allergic must be considered and ruled out. Likewise bone marrow must show evidence of normal or increased granulopoietic activity. If no cause can be found and the bone marrow shows such increased activity, splenectomy is indicated for this condition. The response is immediate and lasting. Although enough time has not elapsed to evaluate the duration of the results of splenectomy in this syndrome, relapses appear to be rare.

Primary Splenic Panhematocytopenia—Splenic involvement has been considered in the abnormal hematologic balance seen in cases of hemolytic anemia (red blood cells), idiopathic neutropenia (neutrophilic cells) and idiopathic thrombocytopenia (platelets). In cases in which all three elements are involved the condition has been called splenic panhematocytopenia. In these patients there is a marked reduction of red blood cells, hemoglobin, neutrophils and platelets in

the peripheral blood Bone marrow studies disclose a compensatory

anemia⁴ actually are examples of this syndrome Cases may be acute and fulminating, requiring emergency splenectomy while others are chronic and gradually become more pronounced until repeated transfusions are necessary to sustain life Splenectomy is indicated in all such cases when no etiologic factor can be found The cause of the splenic imbalance in this syndrome is not understood

Secondary Splenic Panhematocytopenia—The normal function and balance of the spleen may be upset to varying degrees in many diseases Lymphoblastoma Hodgkin's disease rheumatoid arthritis sarcomas drug sensitivities as in some cases of benzol poisoning and Gaucher's disease are examples of etiologic factors that may cause this syndrome Selected cases in this group respond well to splenectomy Hodgkin's disease may have its first manifestation in hematologic abnormalities of this type and the diagnosis at times is made only when the spleen is observed histologically after its removal Such patients may do well with complete remission of the hematologic abnormalities for some months or even years after splenectomy Patients with Gaucher's disease of the chronic type show marked improvement after splenectomy when panhematocytopenia is present in the peripheral blood and when there is compensatory hyperplasia of the bone marrow

Congestive Splenomegaly—Any condition that partially or totally obstructs the splenic vein or any portion of the portal system at or above the level of the splenic vein will cause congestive splenomegaly and lead to an engorgement of the collateral circulation involving the vasa brevia and the esophageal veins The resulting varices often bleed severely and at times fatally The most common site of portal obstruction is within the liver itself where cirrhosis impedes the normal portal flow Congenital abnormalities of the portal vein thrombosis of the splenic vein and schistosomiasis mansoni are much less common causes of this syndrome If the process involves the liver as it so commonly does death from hepatic failure is the end result if hemorrhage from varices has not already proved fatal

Patients in whom the spleen or splenic vein alone is involved will be cured by splenectomy Any patient with congestive splenomegaly will be helped by splenectomy in that 40 per cent of the portal blood is derived from the splenic circuit and the portal hypertension will be greatly diminished by the removal of this source of incoming blood Furthermore the tendency to panhematocytopenia will be favorably influenced by splenectomy

Any patient with congestive splenomegaly who will stand the operative procedure should be subjected to splenectomy Unfortu

nately, in all too many patients suffering from this syndrome the condition is far advanced before the question of splenectomy is considered. In such circumstances, the danger of the procedure too often is prohibitive. If the physician could see such patients early and splenectomy be performed at that time, much could be gained by the procedure.

CONTRAINDICATIONS

The most important contraindication to splenectomy is agnogenic myeloid metaplasia in which the bone marrow loses its ability to make red blood cells, platelets and granulocytes because of the overgrowth of fibrous tissue and in some cases of bony tissue. Under these circumstances the spleen and, to a lesser extent, the liver and kidneys take over hematopoiesis. If the spleen is removed, the main source of blood formation is lost. Bone marrow studies in all cases in which splenectomy is considered are essential and will prevent mistakes of this sort. Removal of the spleen in cases of leukemia and polycythemia is without merit and, in general, is contraindicated.

DISCUSSION

With our increasing knowledge of the spleen, its functions and dysfunctions, the indications for splenectomy have increased. Careful study of each case is of the utmost importance. Exact hematologic diagnoses are essential when possible if the best results are to be obtained. The interest of physicians and surgeons must be stimulated to recognize splenomegaly in its early stages and to study it at that time if the greatest good is to be derived from splenectomy. Cases of splenomegaly which after observation and extensive hematologic study defy diagnosis deserve splenectomy. It is in this way that our knowledge will be most rapidly advanced and our patients will derive the most benefit.

SUMMARY

Our knowledge of the spleen and its hematologic functions is steadily increasing.

The individual indications for splenectomy are discussed.

Agnogenic myeloid metaplasia is the most important contraindication to splenectomy.

_____ is essential to the most satisfactory

_____ in those cases of splenomegaly in which the cause cannot be determined.

TOTAL GASTRECTOMY

SAMUEL F. MARSHALL AND LOWELL H. BROWN

TOTAL gastrectomy refers to a radical operative procedure designed to remove the entire stomach, in most instances for extensive malignancy arising in that organ. During the past ten years there has been a recrudescence of interest in this method of operative approach to the problem of gastric malignancy, and in most instances this has been

regard to the postoperative morbidity or mortality or its effect upon prolongation of life

INDICATIONS

Surgery in its first effect should be designed to relieve suffering and to prolong life, in short, a postoperative existence which has the hope of comfort, freedom from pain and reasonable usefulness on the part of those trusting their lives to the surgeon. Radical surgical procedures which are accompanied by high mortality, as is total gastrectomy, which give rise to immediate postoperative distress incident to any major operation and which do not prolong life beyond at least the anticipated average period of unoperated similar cases, can do little to enhance the reputation of the careful, thoughtful surgeon or of the surgical profession. Only recently we have noted in the literature unwarranted favorable conclusions in regard to total gastrectomy in a report of a small series of cases of total gastrectomy in which 30 per cent of the patients operated upon succumbed to recurrent malignant disease two to three months after operation. The natural expectancy of life in an unoperated series of cases similar to 30 per cent of the group referred to above in our experience has been five and one-half to six months. It is obvious to even a mildly critical observer of surgery that lesions
be removed with an
should not be undertaken
method however, total gastrectomy is a valuable procedure and in properly selected cases is an extremely useful surgical approach to extensive malignancy. Only cases in which the stomach has been completely removed with no portion of the stomach being left, with anastomosis of the esophagus to some part of the small bowel, would be termed total gastrectomy. This anastomosis of the esophagus has been made to the duodenum or jejunum but in the more recent re-

ports of these cases, in most instances the esophagus has been anastomosed to the jejunum.

Conner of Cincinnati, in 1884, was the first to report complete removal of the stomach in a man, but his patient died on the operating table. In 1897 Schlatter completed a successful total removal of the stomach and his patient lived one year and fifty three days after operation. Numerous reports of single or isolated cases of successful total gastrectomy appear in the literature but until the last eight or ten years, no large series has been reported from any surgical clinic. Finney and Rienhoff, in 1929, reported an analysis of a collected series

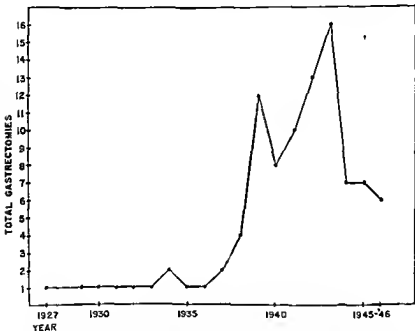


Fig. 237—Number of total gastrectomies from 1927 to 1946, inclusive

of 122 cases of total gastrectomy in the literature to that date. In this group they reported 5 cases of their own and stated that after critical analysis of the group of collected cases there were only 62 cases of true total gastrectomy and in 55 cases of this group of 122, less than 3 cm. of the stomach remained. The operative mortality rate was 53.8 per cent in the 67 patients who had definite total gastrectomies.

In 1943, Pack and McNeer, in an excellent collective review of the literature to July 1, 1942, reported an analysis of 303 collected cases of total gastrectomy which included 20 cases in which total gastrectomy was performed by them. In their group of 20 cases there

were 6 operative deaths, a mortality of 30 per cent, whereas there was an operative mortality of 37.6 per cent for 298 total gastrectomies collected over the period of 1884 to 1942.

It is during the last ten years that interest in this problem has been most active and has been most productive of numerous reports of series of cases especially of relatively larger groups of patients operated upon in clinics or by individual surgeons.

In 1938 Dr. Lahey⁴ reported on 5 successful cases of total gastrectomy, and from that date our own interest in this operation was

TABLE 1
TOTAL GASTRECTOMY, 1927-1946 INCLUSIVE

Year	Total Gastrectomy, Number	Postoperative Deaths Number	Operative Mortality Per cent
1927 to 1937 inclusive	12	5	41.6
1938	4	1	25.0
1939	12	3	25.0
1940	8	5	63.0
1941	10	5	50.0
1942	13	2	15.4
1943	16	3	18.7
1944	7	1	14.3
1945	7	1	14.3
1946	6	1	16.6
Total	95	27	28.4

From 1942 to January 1, 1947

49 total gastrectomies—3 deaths
operative mortality 16.3 per cent

Prior to 1942

46 total gastrectomies—19 deaths
operative mortality 41.3 per cent

stimulated and the number of patients having this operation increased rapidly (Fig. 237).

In 1944, Lahey and Marshall⁶ reported the results to October 1943 in a group of 73 cases in which the operative mortality for the entire group was 33 per cent. This mortality rate, however, included the earlier cases of total gastrectomy, our first case being done in 1927. Prior to January 1, 1942, 46 total gastrectomies were performed in this clinic, with an operative mortality of 41.3 per cent. Since this report in 1944 total gastrectomy has been carried out in 22 additional

cases up to January 1 1947 making in all a series of 85 cases of total gastrectomy done at the Lahey Clinic. The operative mortality in 49 consecutive cases in which total gastrectomy was done since January 1, 1942, has been 16.3 per cent—a noteworthy reduction in operative mortality as compared to the rate (41.3 per cent) prior to January 1 1942 (Table 1).

The reduction in operative mortality can be attributed to a number of factors: experience gained in the performance of the operation, better operative technique, better selection of cases, improved anesthesia and better understanding of preoperative and postoperative care of these patients, particularly in relation to knowledge of blood chemistry, vitamins and blood proteins. Of considerable significance also

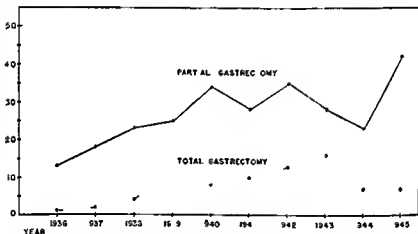


Fig. 238—Resection for carcinoma of the stomach 1936 to 1945 inclusive. The number of total gastrectomies compared with the number of partial resections done each year is shown.

is the effect of chemotherapy, particularly sulfonamide and penicillin therapy. These drugs have been invaluable to us in improving our results and avoiding postoperative complications such as wound infection, peritonitis and chest complications. One other factor which has been of

importance is the effect of avoiding postoperative deaths resulting from serious pulmonary complications.

It is also of interest to note the relative proportion of total to partial gastrectomies over the period from 1936 to 1945 (Fig. 238). During a six year period, 1939 to 1944 inclusive, there was a relatively higher proportion of total gastrectomies in relation to partial gastrec-

tomies than before 1939 or 1945. Perhaps this was the result of an effort to increase the operability in cases of advanced cancer and with it a resultant rise in operative mortality. With increase in experience and with improvement in certain technical features, however, the operative mortality dropped remarkably (Table 1). Out of this has also come a better selection of cases fitted for such a radical procedure and the mortality rate has more or less remained constant from 1942 to 1946, as may be noted in Table 1. From 1944 to 1946 total gastrectomy was done in even fewer cases. This, we are sure, is based upon better selection of cases and the realization that one must be able to remove cleanly all demonstrable cancer if results are to be all that is desired.

Waugh and Fahlund reported a similar experience with total gastrectomy at the Mayo Clinic. They reported a series of 77 cases of total gastrectomy done by the abdominal route from 1917 to 1943 inclusive, in 33 cases from 1917 to 1939 operation was performed with a mortality of 60.6 per cent, whereas in a group of 44 cases in which operation was carried out from 1940 to 1943 inclusive, the operative mortality was 31.8 per cent. Twenty of these patients were operated on in 1943 with 5 operative deaths, a mortality of 25 per cent.

In the main, there is only one definite indication for total gastrectomy and that is when a tumor so involves a stomach that it cannot be completely removed by partial gastrectomy. Total gastrectomy is to be avoided if all demonstrable tumor cannot be removed at the time of operation. Evidence of widespread or distant metastases precludes the employment of this operation and in some of the cases this can

involved areas can be included in the radical extirpation of the malignant lesion, and this seldom proves to be possible. Portions of the pancreas can be included in this surgical removal. The spleen should be removed in the majority of these cases, in our hands this is always done without increase in mortality and its removal really simplifies the complete mobilization of the stomach.⁶ Total gastrectomy is indicated in tumors of the cardia and fundus or in widespread malignant disease confined to the stomach, such as linitis plastica. When roentgen ray studies indicate extensive involvement of the stomach with carcinoma and total gastrectomy must be considered, it is important to determine whether the esophagus is involved. The roentgen ray studies in most cases will indicate encroachment upon the esophagus, dilatation or obstruction of the esophagus is evidence of this and further information can be obtained by esophagoscopy. Should roentgenologic and endoscopic examination indicate involvement of the esophagus, trans-thoracic resection of the cardia or even total gastrectomy should be done by this route.

All of this group of patients (95) have had resection by the transabdominal route and none of the transthoracic resections are included in these figures. In general, we prefer transabdominal approach in all these cases. This type of operation carries less operative risk and morbidity and a more thorough removal of lymphatic nodes can be



Fig. 239—The omentum has been detached from the transverse colon. The lesser omental cavity has been entered, allowing the posterior gastric wall to be visualized. Involvement of the pancreas or retroperitoneal tissues can be found readily and operability at once determined before proceeding with total gastrectomy.

done through the abdomen. It is obvious that there will be some cases in which in anes mortal spinal anesthesia after the removal of the tumor can be used in these cases. Anesthesia can be maintained for long periods with perfect re-

laxation and without shock. It can also be supplemented by curare or sodium pentothal given intravenously if greater relaxation is needed or if it is desired to have the patient asleep during the procedure.

TECHNIC

We will not attempt in this paper to give detailed direction of the operative technic of total gastrectomy as employed at the Lahey

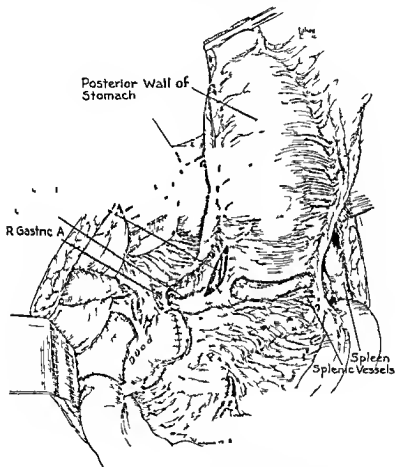
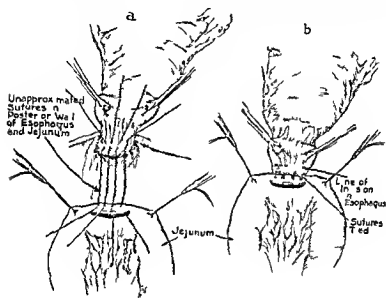


Fig. 240—The duodenum has been divided and closed by inverting sutures. Note splenic vessels which can be divided and ligated easily to permit splenectomy. With division and ligation of left gastric vessels mobilization of entire stomach is now practically complete.

Clinic as this has been given fully in previous communications. The essential features of the operation are shown in the illustrations (Figs 239 to 242). A long left rectal incision is made extending to the costal

margin and to a level below the umbilicus. The location and the amount of involvement of the stomach are determined and a search is made for peritoneal implants and liver metastases. If the stomach can be mobilized and the esophagus and diaphragm are not invaded with neoplasm, gastrectomy can be proceeded with. We always detach the omentum from the colon which permits ready exposure of the lesser omental cavity and permits the surgeon to ascertain if there is extension of tumor to the pancreas or retroperitoneal structures. As already stated, the spleen is always removed as proposed by Dr. Lahey when total gastrectomy is done and we have seen no difficulty arise



from this procedure as Graham has suggested may occur with splenectomy. It facilitates mobilization of the stomach and permits removal of involved splenic groups of nodes. After the stomach is completely mobilized, the stomach is turned upward over the left costal margin and not detached from the esophagus until the anastomosis between the esophagus and jejunum is begun by completing the posterior suture line of the anastomosis. Enteroenterostomy is always done between efferent and afferent loops of jejunum which will allow direct passage of bile and pancreatic juices from the proximal to the distal loop of jejunum without coming in contact with the lower end of the esophagus.

agus. This anastomosis will also prevent dilation and obstruction of the proximal jejunal loop which may occur at the esophagojejunal anastomosis as a result of edema or narrowing of the esophagus at the

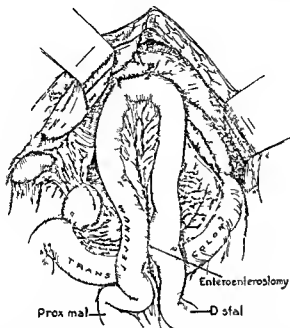


Fig. 242—The completed esophagojejunal anastomosis is illustrated. Note enterointerostomy between proximal and distal loops of jejunum.

suture line. Dilation of the proximal loop with liquid contents has been responsible for leaks at the anastomosis and subsequent contamination and peritonitis.

RESULTS

There were 27 postoperative deaths in this series of 95 patients. The majority of deaths (15) resulted from contamination and infection such as peritonitis, abscess, and so forth. Eight deaths followed serious chest complications such as pneumonia, mediastinitis, and pulmonary infarction. It is conceivable that many of these complications in the earlier cases could have been avoided by the use of chemotherapeutic agents, but it is important to emphasize that clean surgery, lack of trauma, and contamination are still the most important factors in preventing these complications. Cardiovascular complications accounted for 4 deaths. We shall not attempt to discuss the final postoperative results in this series, as this phase is covered by Smith in a report of 89 cases in this group to which 6 additional cases have been added.

SUMMARY

The results in 95 cases in which total gastrectomy was performed at the Lahey Clinic between 1929 and January 1, 1947, are reviewed. The operative mortality in 46 cases in which operation was done during the period from 1927 to January 1942, was 41.3 per cent. The operative mortality in 49 consecutive cases since 1942 was 16.3 per cent.

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CARCINOMA OF THE STOMACH—RATE OF OPERABILITY

SAMUEL F. MARSHALL AND MARK L. WELCH

CARCINOMA of the stomach presents an especially serious aspect to the diagnostician and surgeon because of the apparently low rate of resectability which is evidenced by reports of many series of cases. The low rate of operability is almost entirely dependent upon the delay in diagnosis. The frequent occurrence of malignant disease of the stomach is apparently not yet fully recognized and this fact should constantly be emphasized in order to prevent delay in employment of diagnostic procedures. Approximately 30,000 persons a year die from carcinoma of the stomach. It is the most frequent form of malignant disease found in the male, of about 1 in 5 males who die of malignant disease the initial lesion arises in the stomach.

Carcinoma of the stomach occurs nearly twice as frequently in men as in women, this ratio in 1943 was 20 males to 11 females according to the Bureau of Vital Statistics.

TABLE 1
TUMORS OF THE STOMACH—464 PATIENTS
(1939-1943)

Benign tumor	9
Sarcoma	15
Carcinoma	440
	<hr/> 464

It is significant, also, to realize that the majority of tumors of the stomach are carcinomatous. A study of a consecutive group of patients with gastric tumor brought to surgery during a five year period (1939-1943) reveals that in 98 per cent the tumor was malignant (Table 1).

It is evident that the incidence of occurrence of benign tumors is low and that the majority of neoplasms of the stomach presents serious problems and demand the earliest possible operation.

All available diagnostic methods to determine the presence of tumor of the stomach should be employed upon the slightest suspicion if progress is to be made in this very serious aspect of malignancy. Fluoroscopic and roentgenologic examination of the stomach has proved to be the most valuable method at present in the diagnosis of malignant disease of the stomach, but gastroscopic examination should be employed more frequently, and one should not hesitate to utilize exploratory laparotomy in the event that other diagnostic methods do not positively rule out gastric neoplasm. The cytologic diagnosis of

gastric carcinoma as advocated by Papanicolaou is an added valuable

come to the physician because of symptoms of gastric distress which have been present for many months or have had treatment and diets for long periods before any positive effort is made to establish a diagnosis

TABLE 2

CARCINOMA OF THE STOMACH OPERABILITY IN 633 PATIENTS
(1936 to 1945 Inclusive)

	Patients		Postoperative	Mortality,
	Number	Per cent	Deaths	Per cent
Exploration and biopsy	300	45.7	15	5
Palliative operation	84	13.0	16	19
Partial gastrectomy	269	41.0	31	11.5

In the Lahey Clinic over a period of ten years, 1936 to 1945 inclusive, 633 patients have been operated on for carcinoma of the stomach. Of this group, resection was possible in only 269 patients, or 41 per cent (Table 2)

From Table 2 it is evident that the rate of resectability is less than half of the number of patients submitted to operation in this instance 41 per cent. This figure includes not a few instances of resection being done in patients with advanced disease for purely palliative purposes

TABLE 3

CARCINOMA OF THE STOMACH PREOPERATIVE DIAGNOSIS IN 469 PATIENTS
(1938 to 1940 Inclusive)

	No. of Patients	Operability, Per cent
Inoperable, no exploration	226	48.2
Exploration and biopsy only	91	19.4
Palliative operation	39	8.3
Partial gastrectomy	113	24.1

Operability, however, is even much less (24.1 per cent) when one considers the number of resections that could be done in those cases in which the diagnosis of cancer was incontrovertibly established by various diagnostic methods. In a group of 469 patients upon whom a preoperative diagnosis of carcinoma was made, only 113 patients had resection of their neoplasms (Table 3)

Figure 243 shows the number of patients with cancer of the stomach operated upon each year (1936 to 1945)

In relation to the number of cases in which resection was possible it is evident that the resection rate has not increased and even has declined slightly over a ten year period. This is distinct evidence that

no improvement in earlier diagnosis has been made and this is probably the most discouraging aspect of the problem of gastric carcinoma. Somehow, in some manner, earlier diagnoses of this type of malignancy must be made if we hope to increase operability and thus affect the survival rate after operation.

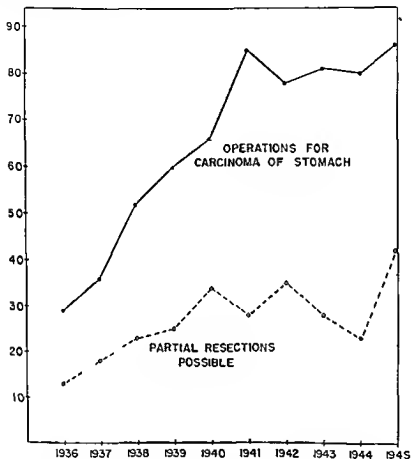


Fig. 243—Number of patients with cancer of the stomach operated upon each year from 1936 to 1945

Our experience in the Lahey Clinic in regard to late diagnosis and late institution of treatment in cases of gastric carcinoma is similar to that reported by other workers in this field. Counseller, in 1945, reported on the experience at the Mayo Clinic from 1928 to 1943, and stated that in approximately half of those patients operated on was resection possible, whereas approximately in only 30 per cent of those in whom a diagnosis was made was resection possible.

gastric carcinoma as advocated by Papanicolaou is an added valuable method for early detection of gastric malignancy. Unfortunately, some patients with gastric malignancy present few symptoms until the lesion reaches an inoperable stage, but it is also true that too many patients come to the physician because of symptoms of gastric distress which have been present for many months or have had treatment and diets for long periods before any positive effort is made to establish a diagnosis.

TABLE 2

CARCINOMA OF THE STOMACH OPERABILITY IN 653 PATIENTS
(1936 to 1945 inclusive)

	Patients		Postoperative	Mortality
	Number	Per cent	Deaths	Per cent
Exploration and biopsy	300	45.7	15	5
Palliative operation	84	13.0	18	19
Partial gastrectomy	269	41.0	51	11.5

In the Lahey Clinic over a period of ten years, 1936 to 1945 inclusive, 653 patients have been operated on for carcinoma of the stomach. Of this group, resection was possible in only 269 patients, or 41 per cent (Table 2).

From Table 2 it is evident that the rate of resectability is less than half of the number of patients submitted to operation, in this instance 41 per cent. This figure includes not a few instances of resection being done in patients with advanced disease for purely palliative purposes.

TABLE 3

CARCINOMA OF THE STOMACH PREOPERATIVE DIAGNOSIS IN 489 PATIENTS
(1936 to 1940 inclusive)

	No. of Patients	Operability Per cent
Inoperable no exploration	228	46.2
Exploration and biopsy only	91	19.4
Palliative operation	39	8.3
Partial gastrectomy	113	24.1

Operability, however, is even much less (24.1 per cent) when one considers the number of resections that could be done in those cases in which the diagnosis of cancer was incontrovertibly established by various diagnostic methods. In a group of 489 patients upon whom a preoperative diagnosis of carcinoma was made, only 113 patients had resection of their neoplasms (Table 3).

Figure 243 shows the number of patients with cancer of the stomach operated upon each year (1936 to 1945).

In relation to the number of cases in which resection was possible it is evident that the resection rate has not increased and even has declined slightly over a ten year period. This is distinct evidence that

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Thorstad reported from Detroit on two series of cases as follows of 454 cases in the Harper Hospital the tumor was clinically inoperable in 42.3 per cent and only 19.4 per cent of the patients had resections. Of 516 cases from the Detroit Recovery Hospital, the tumor was clinically inoperable in 76.6 per cent when the patient was first seen and in only 9.8 per cent could it be resected.

Custer reported a group of 463 patients upon whom laparotomy was done. In 141 patients resection was possible a resectability rate of 30.4 per cent. Eliason and Witmer in a report of 149 patients from the Hospital of the University of Pennsylvania stated that in only 3.3 per cent was the neoplasm resectable. Of this group of 149 cases exploratory laparotomy was performed in 91 per cent. 9 per cent did not have exploratory laparotomy. Of those cases explored the disease was already too advanced to permit resection in 36 cases.

From these figures it is apparent that for some reason or other diagnosis is made in the majority of cases much too late. Although the problem in gastric malignancy is discouraging from the standpoint of treatment, it is not hopeless. Too much pessimism exists in the medical profession in regard to gastric carcinoma and with such a philosophy and approach to this problem very little can be accomplished. Rather should the physician be constantly reminded of the frequency of gastric malignancy. Emphasis should be placed on earlier application of diagnostic methods in those patients past the age of 45 who have gastric distress. We should not be satisfied until every diagnostic procedure at hand demonstrates the absence or presence of a gastric neoplasm.

any circumstances and more especially clinical interpretation of any type of gastric distress should not be permitted until adequate study

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to the physical signs by which it can be recognized at operation, as well as to present a method for its relief

The symptoms presented by patients with obstructive jaundice due to carcinoma are well recognized and need not be enumerated. The earliest symptoms associated with obstruction to the pancreatic ducts are the direct result of a diminished amount of external pancreatic secretion in the intestinal tract. A change in bowel function is frequently the first symptom. An unusual amount of intestinal gas may be present with occasional watery stools or intermittent diarrhea. The stool may become foamy and of increased bulk. General abdominal discomfort and indigestion are frequent complaints. The patient may complain of a sensation of pressure low in the epigastrium. Back pain may be the only localizing symptom. This may be more prominent while lying down, and interfere with sleep. The most comfortable position for the relief of this symptom is found by sitting up and leaning forward. This pain is usually more pronounced on the right side, although usually it passes across the median line. When the malignancy is primary in the duct of Wirung or in the head of the pancreas, the process may extend considerably before causing obstructive jaundice. These patients may develop anorexia, weight loss, anemia and weakness. When the carcinoma is in the body of the pancreas the malignancy may be quite extensive before there are sufficient localizing symptoms to suspect the pancreas as the site of origin. Since physical examination may be negative, and laboratory and roentgenologic findings inconclusive, exploration is too often delayed until no surgical relief is possible.

In our earlier experience, no attempt was made to differentiate clinically between carcinoma of the body of the pancreas, carcinoma of the head of the pancreas or carcinoma of the ampulla of Vater. Any patient who presented progressive painless jaundice and who had enlargement of the liver and a palpable gallbladder had a diagnosis of carcinoma of the pancreas. Following a review of over 100 histories of patients with this condition and with the recognition of the symptoms that follow exclusion of the pancreatic juice from the gastrointestinal tract, we have been able to make a much more accurate diagnosis of the location of the carcinoma causing the obstructive jaundice. It is possible to differentiate carcinoma of the ampulla from carcinoma of the head of the pancreas by reviewing the order of onset of symptoms. Carcinoma that begins in the head of the pancreas will usually cause obstruction of the ducts of Wirung and Santorini before obstruction of the common bile duct. Thus, the symptoms of indigestion, gas, bloating, diarrhea and bulky foamy stools will be

are encroached upon are the other symptoms produced.

ANASTOMOSIS OF THE DUCT OF WIRSUNG

Its Use in Palliative Operations for Cancer of the Head of the Pancreas

RICHARD B. CATTELL

some prospect of cure. This leaves a large proportion of patients in whom only means of palliative benefit are available. In a recent review of 56 patients with carcinoma of the head of the pancreas who were operated on previous to 1935 when Whipple's first radical resection was presented, we were surprised to find that the duration of life following the anastomosis of the biliary tract to the intestinal tract was short. Of the patients surviving the relatively simple procedure of cholecystojejunostomy 75 per cent were dead within six months of operation or nine months after the onset of their obstructive jaundice.

The most conspicuous symptoms associated with carcinoma of the head of the pancreas are those which are the result of the obstruction of the biliary tract. The intense and persisting pruritus that shows little response to medical measures of relief, quickly responds to the short circuiting operation of joining the gallbladder to the intestinal tract. If the gallbladder is not available because of previous disease

jaundice but has the necessary for normal or whole bile offers a cases

A patient with obstructive jaundice due to carcinoma of the head of the pancreas who has had cholecystojejunostomy is very appreciative of the immediate relief of his pruritus. Even though the surgeon recognizes that such a palliative procedure may offer a reasonable survival period of relative comfort *he may be less aware of the digestive disturbances which continue unabated by the relief of the obstructive jaundice*.

Insufficient attention has been called to the associated condition present in most of these patients, that of obstruction of the pancreatic duct. It is the purpose of this paper to emphasize the symptoms related to the obstruction of the pancreatic ducts and to call attention

to the physical signs by which it can be recognized at operation, as well as to present a method for its relief

The symptoms presented by patients with obstructive jaundice due to carcinoma are well recognized and need not be enumerated. The earliest symptoms associated with obstruction to the pancreatic ducts are the direct result of a diminished amount of external pancreatic secretion in the intestinal tract. A change in bowel function is frequently the first symptom. An unusual amount of intestinal gas may be present with occasional watery stools or intermittent diarrhea. The stool may become foamy and of increased bulk. General abdominal discomfort and indigestion are frequent complaints. The patient may

have pain in the epigastrium. Back

This may be more prominent

The most comfortable position for the relief of this symptom is found by sitting up and leaning forward. This pain is usually more pronounced on the right side, although usually it passes across the median line. When the malignancy is primary in the duct of Wirsung or in the head of the pancreas, the process may extend considerably before causing obstructive jaundice. These patients may develop anorexia, weight loss, anemia and weakness. When the carcinoma is in the body of the pancreas the malignancy may be quite extensive before there are sufficient localizing symptoms to suspect the pancreas as the site of origin. Since physical examination may be negative, and laboratory and roentgenologic findings inconclusive, exploration is too often delayed until no surgical relief is possible.

In our earlier experience, no attempt was made to differentiate clinically between carcinoma of the body of the pancreas, carcinoma of the head of the pancreas or carcinoma of the ampulla of Vater. Any patient who presented progressive painless jaundice and who had enlargement of the liver and a palpable gallbladder had a diagnosis of carcinoma of the pancreas. Following a review of over 100 histories of patients with this condition and with the recognition of the symptoms that follow exclusion of the pancreatic juice from the gastrointestinal tract, we have been able to make a much more accurate diagnosis of the location of the carcinoma causing the obstructive jaundice. It is possible to differentiate carcinoma of the ampulla from carcinoma of the head of the pancreas by reviewing the order of onset of symptoms. Carcinoma that begins in the head of the pancreas will usually cause obstruction of the ducts of Wirsung and Santorini before obstruction of the common bile duct. Thus, the symptoms of indigestion, gas, bloating, diarrhea and bulky foamy stools will be initial symptoms. On the contrary, carcinoma of the ampulla of Vater causes early obstruction of the common bile duct so that pruritus and jaundice are the first symptoms and only later as the pancreatic ducts are encroached upon are the other symptoms produced.

without any dissection and the area of the duct can be felt through either the gastrobepatic or gastrocolic omentum without opening these structures. The duct is most readily felt in the body in its mid portion before it joins the neck. The duct runs a longitudinal course nearer the anterior surface of the pancreas and usually is at the junction of the middle and upper third of the body. The normal duct cannot be palpated but when dilatation is present as the result of obstruction, one can pass the pulp of the index finger deeply into the fluctuant course of the duct. If further evidence is needed to prove its dilatation a needle can be passed into the duct and clear pancreatic juice evacuated. A normal duct cannot be identified by this means. As experience increases in palpation of the pancreas, one can readily detect changes of the duct system.

In carcinoma of the head of the pancreas, the duct of Wirsung is usually dilated and can be palpated without difficulty. The duct may vary in size depending on the duration and completeness of the obstruction, from a few millimeters in diameter to 2 cm in diameter. The largest duct system that we have explored held over 800 cc. of clear pancreatic fluid. At times the acinar cells of the pancreas have been little in evidence and the duct system will make up most of the pancreatic mass that can be felt.

With these findings recognized it will at once be evident that relief of the obstruction can readily be accomplished by anastomosis of the duct to the intestinal tract in a manner similar to that for the relief of the biliary obstruction. We have now had considerable experience in the identification of the duct of Wirsung in these cases. It has been anastomosed to the jejunum forty times in 41 radical pancreatoduodenal resections when it was feasible to resect the carcinoma. In only one resection, our first one performed in August 1940 have we failed to anastomose the duct in one of these resections. It is our firm opinion that this is the most important factor in reducing serious complications following resection of the head and has been a material factor in keeping the operative mortality down to approximately 17 per cent. In only 1 patient in whom the duct was anastomosed following resection did the anastomosis fail to be maintained. Failure to anastomose the duct may result in an external pancreatic fistula which may lead to postoperative hemorrhage or retroperitoneal sepsis. Furthermore failure to anastomose the duct, even though serious complications are avoided, usually leads to sufficient physiologic disturbances in digestion that pancreatic replacement therapy is necessary and even with it nutrition still is impaired and few patients regain their normal weight.

In patients in whom resection is not feasible because of distant spread or local invasion, it may still be possible to return the pancreatic juice to the intestinal tract as well as relieve the obstructive jaundice. In 14 patients in whom we thought resection was not feasible we have anastomosed the duct of Wirsung as well as the gall-bladder to the jejunum, thus relieving both the pancreatic and biliary obstructions. There has been no postoperative death in these 14 cases even though these patients represent poor surgical risks.

The exposure of the pancreas for this anastomosis is best accomplished by dividing the gastrocolic omentum. The lesser peritoneal

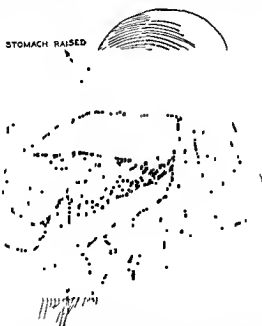


Fig. 244—Exposure of the pancreas is best obtained by division of the gastrocolic omentum.

the ligament of Treitz.

The duct of Wirsung must be anastomosed to the jejunum in continuity, in other words, a side-to-side anastomosis must be made since division of the pancreas would leave the distal duct obstructed. We have accomplished this anastomosis by two technical procedures.

1. If only moderate distention of the duct is present, the jejunum is

Obstruction of the duct of Wirsung is easy to recognize at operation. Palpation of the body of the pancreas enables one to determine whether the body is diffusely enlarged and firm, with blunting of the tail. It also permits digital palpation of the duct itself. This is possible

before it joins the neck. The duct runs a longitudinal course nearer the anterior surface of the pancreas and usually is at the junction of the middle and upper third of the body. The normal duct cannot be palpated but when dilatation is present as the result of obstruction, one can pass the pulp of the index finger deeply into the fluctuant course of the duct. If further evidence is needed to prove its dilatation, a needle can be passed into the duct and clear pancreatic juice evacuated. A normal duct cannot be identified by this means. As experience increases in palpation of the pancreas, one can readily detect changes of the duct system.

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In patients in whom resection is not feasible because of distant spread or local invasion, it may still be possible to return the pancreatic juice to the intestinal tract as well as relieve the obstructive jaundice. In 14 patients in whom we thought resection was not feasible we have anastomosed the duct of Wirsung as well as the gall-bladder to the jejunum, thus relieving both the pancreatic and biliary obstructions. There has been no postoperative death in these 14 cases even though these patients represent poor surgical risks.

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sutured to the mid portion of the body of the pancreas, following which the seromuscular coat of the jejunum is divided, exposing the mucosa. The anterior surface of the pancreas is incised over the duct

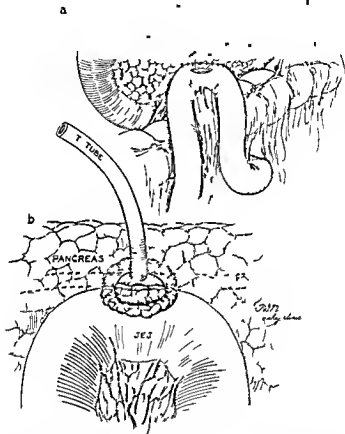


Fig 245—*a*, Anastomosis of the duct of Wirsung to the jejunum by the necrosing suture technic. The seromuscular coat of jejunum is incised. The pancreas is entered over the duct and a silk suture is passed into the duct and jejunal mucosa.

b, When the duct of Wirsung is markedly dilated an open anastomosis is preferable. The mucosa of the duct is sutured to the mucosa of the jejunum over a T tube.

but is not entered (Fig 245 *a*) A braided silk suture is then passed through the anterior wall of the duct and through 1 cm. of the exposed jejunal mucosa and is tied tightly. The opposite side of the

jejunum is then sutured to the upper side of the pancreatic body above the duct.

2. If the duct of Wirung is large, it is opened for a distance of 2 cm., a T tube inserted into it and an open anastomosis performed to the jejunum, suturing the mucosa of the duct to the mucosa of the jejunum with a nonabsorbable suture line outside (Fig 245, b)

When this anastomosis has been completed either by the necrosing suture technic or by open anastomosis, the efferent loop of the jejunum is then brought over to the gallbladder and a cholecystjejunostomy done 3 or 4 inches (7.5 to 10 cm) distal to the pancreatic anastomosis. The operation is completed by doing an entero enterostomy 4 inches (10 cm) proximal to each of the two previous anastomoses, thus

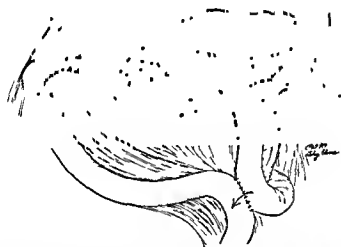


Fig 246—The usual cholecystjejunostomy is shown distal to the pancreatojejunal anastomosis. A jejunojejunostomy short circuits the two anastomoses.

short circuiting them to avoid regurgitation into the two duct systems (Fig 246)

The relief that may be accomplished by anastomosis of the duct of Wirung in an inoperable carcinoma of the head of the pancreas is well illustrated by the following case report

REPORT OF CASE

This patient was first seen July 9, 1943. He had been well until January, 1944, eighteen months previously, when he first consulted his physician because of indigestion and watery stools. A complete gastrointestinal roentgenologic study was done, which was negative. No abnormality of the stomach or duodenum was noted and the colon appeared normal. In spite of the negative findings he was treated for peptic ulcer. In October, 1944, he had a six-day illness with epigas-

tric discomfort, back pain and fever, but no jaundice. His highest temperature was 101°. A cholecystogram was made which showed filling of the gallbladder but delay in emptying. He was then well for three months, when attacks developed of epigastric pain, chills, fever, nausea and vomiting, and in January, 1945, jaundice was first noted. During this time he had lost over 50 pounds from a normal weight of 200 to 146 pounds. In February, 1945, he was operated on at another hospital, at which time a large dilated gallbladder was found, the common duct was dilated with edema of the gastrohepatic omentum, and there was a hard symmetrical tumor in the head of the pancreas. Cholecystostomy was performed and he made a good recovery from operation and was reasonably comfortable as long as the gallbladder sinus remained open. However, his bowel symptoms and epigastric discomfort continued.

At our initial examination in July, 1945, his weight was 150 pounds. There was a small sinus in the right upper quadrant incision which drained mucus and bile. His blood studies showed no secondary anemia. The prothrombin was 90 per cent of normal, the blood bilirubin 1.9 mg per cent.

The patient was operated on July 13, 1945. A large symmetrical tumor, 8 cm in diameter, was found filling the head of the pancreas. It obstructed the common bile duct which was 3 cm in diameter. The gallbladder was dilated in spite of the persisting sinus which communicated with it. After dissection of the gastrohepatic and gastroduodenal ligaments, with division of the right gastric and gastroduodenal arteries, the tumor was found to be invading the portal vein and adherent to the superior mesenteric vessels. The tumor extended posteriorly to involve the jejunum in the region of the ligament of Treitz. The duct of Wirsung was 1.5 cm in diameter and could be readily palpated. Regional lymph nodes were removed for study but did not show metastases. The tumor was considered to be inoperable because of invasion of the portal vein and superior mesenteric vessels. A side to side anastomosis between the duct of Wirsung and the jejunum was performed utilizing a necrosing silk suture technique to establish the anastomosis. The gallbladder was detached from the abdominal wall and a cholecystojejunostomy performed. A jejunojejunostomy was then done 3 inches (7.5 cm) proximal to these two anastomoses.

The patient made a good recovery from operation and was discharged from the hospital July 31, eighteen days after operation.

He was reexamined September 13, 1945, October 29, 1945, and January 4, 1946. At the visit on January 4 he weighed 169 pounds and was actively working and felt greatly improved. His epigastric pressure and discomfort were relieved. He had been taking vitamin B₁ and pancreatic capsules. Recurrent headaches had developed but roentgenograms of the cervical spine and skull were negative for metastases. He had one formed stool daily of normal color but of somewhat increased bulk. There was no jaundice, and blood bilirubin was normal.

In December 1946 he weighed 180 pounds but had had occasional digestive upsets and abdominal discomfort, the latter relieved by lying down. On several occasions he had had epigastric pain lasting from one to three days with loss of appetite and occasional headache. The attacks would clear within ten days to two weeks. He was continuing to be active in his business.

COMMENT

In spite of the usual course of carcinoma of the pancreas which leads to death in 75 per cent of cases within nine months of the onset

of obstructive jaundice, some patients live for a considerable period. This patient has been under observation for two years from the onset of his symptoms, and eighteen months after relief of his biliary and pancreatic obstruction. The conspicuous feature of his course was the relative degree of comfort that followed the palliative procedure especially his proven ability to regain and maintain an essentially normal weight. His digestive and bowel functions were markedly improved and to a much greater degree than we have observed following cholecystjejunostomy alone. Except for occasional attacks of abdominal discomfort, epigastric pain and indigestion, he has been relatively free of symptoms during this period of observation. From a clinical viewpoint he has had no return of obstructive jaundice and his pancreatic duct anastomosis has remained open. This case presents an unusually favorable response to duct anastomosis and is one of the most favorable results that we have observed in the 14 patients in whom this procedure has been carried out.

The back pain, epigastric discomfort and pain have usually been considered to be due to extension of the malignancy. In a number of patients we have seen pain relieved following relief of obstruction of the pancreatic ducts, and believe that such obstruction may be responsible for pain and discomfort in these cases. From our observation of patients who have had relief of obstructive jaundice by cholecystjejunostomy, we conclude that gain in weight cannot be anticipated. This has been equally true of patients who have had pancreatoduodenectomy performed without anastomosis of the pancreas to the jejunum. For this reason we recommend anastomosis of the duct of Wirung in all cases in which pancreatoduodenal resection is done and in suitable cases of inoperable cancer of the head of the pancreas for the palliative benefit which may occur.

SUMMARY

Obstruction of the duct of Wirung is a common finding in cancer of the head of the pancreas. It leads to marked disturbance of nutrition and causes digestive and bowel symptoms.

A new method of anastomosis of the duct of Wirung to the jejunum in cases of inoperable carcinoma of the head of the pancreas is presented. This may be done as an open anastomosis over a T tube or as a closed anastomosis with a necrosing suture technic.

Anastomosis of the duct of Wirung in inoperable cases restores the pancreatic juice to the intestinal tract and may be followed by temporary dramatic relief of digestive symptoms and by satisfactory gain in weight.

A case is reported to illustrate what may be accomplished by this procedure. Anastomosis of the duct of Wirung as well as anastomosis of the biliary tract to the jejunum should be done whenever feasible to offer the greatest possible palliative benefit.

TUMORS OF THE SMALL INTESTINE

RICHARD B. CATTELL AND BENTLEY P. COLCOCK

TUMORS of the small bowel, whether benign or malignant, are uncommon. Because they are uncommon, the diagnosis may not be thought of in a patient who complains of mild abdominal cramps or intermittent rectal bleeding. Disease at either end of the gastrointestinal tract—the stomach or colon—is so much more frequent that often all of the diagnostic study is directed toward those regions. Moreover, even when the presence of a small bowel tumor is considered, the diagnosis is often much more difficult to establish than it is in the case of a tumor of the stomach or colon.

These patients may come to a physician because of one or both of two main symptoms, first, intermittent abdominal distress or colic, and second, the presence of blood in the stool.¹ At times the only evidence of the latter may be an unexplained weakness or anemia. The time of onset of these symptoms varies with the type of tumor that is present. Raiford, Lichtenstein and Dutra have pointed out that all tumors of the small bowel fall into two main groups. In the first group are those tumors in which the direction of the growth of the tumor is inward, that is toward or into the lumen of the bowel. This is the largest group and includes most of the benign tumors. Because the growth is toward the lumen of the bowel, symptoms of obstruction occur relatively early. For the same reason, the other common symptom of small bowel tumors, namely bleeding into the gastrointestinal tract, also occurs early. A leiomyoma arising from the muscular coat of the small bowel may represent the source of unexplained intermittent bleeding from the bowel, the cause of which cannot be found in the stomach or colon. Hanno and Mensli reported a case in which repeated episodes of intermittent bleeding occurred over a period of years. The patient was hospitalized on a number of occasions and on one hospitalization a gastro-enterostomy was performed because of the possibility of a duodenal ulcer being present. The diagnosis was not made until the patient came to autopsy as the result of a fatal hemorrhage. The bleeding had come from a benign leiomyoma of the jejunum. Case 4 represents a similar problem in which the diagnosis was finally made by careful fluoroscopic examination of the upper small bowel.

The second group of small bowel tumors includes those tumors in which the direction of the growth is away from the lumen of the bowel. It is the smaller of the two groups but contains most of the malignant tumors. This is unfortunate because in this group the symptoms of obstruction and of bleeding appear much later in the

course of the disease than they do in the first group. Many of these tumors have extended along and into the mesentery before they have produced enough discomfort and obstruction to make the patient seek medical advice (Cases 3 and 5). McDougal has estimated the five year survival rate for tumors of the small bowel at 5 per cent. This is a marked contrast to the 50 per cent five year survival rate which is associated with carcinomas of the colon.

The relatively low incidence of these tumors is shown by Raiford who in a study of 11 500 autopsy specimens plus 45 000 surgical

at the Mayo Clinic and Weber and Kirklin found 41 benign tumors occurring during the same period. Ficarra and Marshall found 12 cases of carcinoma of the jejunum in a thirty year period at the Lahey Clinic. Dixon et al. analyzed exclusive of lesions of the papilla of Vater, 49 cases of malignant lesions of the duodenum. Obstructive features were prominent in 38 while in 6 anemia from loss of blood

was performed in 45 radical resec
and local excision in 1

patient should be placed on a meat

free diet and the stools repeatedly examined for occult blood. The roentgenologic examination of the small bowel calls for careful fluoroscopic study in addition to serial films (Case 4). In patients with signs and symptoms of obstruction a Miller Abbott tube may be passed to the point of obstruction and a roentgenologic study of that particular area made with dilute barium. If these studies are negative and the patient continues to have symptoms or anemia they should be repeated.

Radical resection of the tumor bearing segment and its adjacent mesentery is the only effective form of treatment.

REPORT OF CASES

CASE 1—A man aged 53 years was first seen at the clinic in March 1933. Pain in the abdomen had developed about two weeks previously and he had been operated upon for appendicitis by his local physician. The appendix was normal but a tumor of the sigmoid was found associated with a localized abscess. The tumor had been exteriorized. Cecostomy was done and eight days later a wide excision of the sigmoid and adjacent mesentery was carried out. Later the Mikulicz colostomy was closed.

The patient remained well until August 1937 when he had an intestinal upset associated with abdominal pain and diarrhea. This attack subsided but he continued to feel weak and fatigued. In January 1938 he had an attack of nausea and vomiting. Roentgenologic examination after barium enema at this time was normal. His hemoglobin was 72 per cent, and erythrocytes numbered 4 200 000 and leukocytes 4 250. By June 1938 the hemoglobin had risen to 90 per cent, and erythrocyte count was 4 590 000 on iron and dietary management. He had

several attacks of abdominal pain and constipation. In November and again in January 1939. The latter attacks were again associated with nausea and vomiting. The pain disappeared when he maintained his diet, but he continued to have an anemia. On May 26, 1939, the hemoglobin was 64 per cent, and erythrocytes numbered 3,720,000. A gastrointestinal study at this time showed a normal stomach and duodenum. The duodenal sweep around the pancreas was reported as being wide. The hemoglobin and erythrocyte count came back to normal and in November, six and one half years following the resection of his carcinoma of the sigmoid, he stated that he felt perfectly well. In January 1940 a gastrointestinal roentgenogram revealed a very wide sweep of the second portion of the duodenum. Laparotomy was advised and carried out on January 26.

Abdominal exploration revealed the liver, stomach, duodenum and colon to be normal. There was marked dilatation of the jejunum, beginning at the ligament of Treitz, and ending at a hard malignant growth about 45 cm. below the ligament. In the mesentery immediately adjacent to the growth was a hard mass about 7 cm. in diameter. The tumor and adjacent mass of mesenteric lymph nodes were excised, and a side-to-side anastomosis was done. The pathologic report of the specimen removed was adenocarcinoma of jejunum with metastases to lymph nodes. Convalescence was uneventful and he was discharged on February 14, 1940.

The patient is still in excellent health although retired thirteen years after resection of his colon and six years after resection of an extensive carcinoma of the jejunum.

CASE 2—A man, 45 years of age, came to the clinic March 8, 1934, complaining of abdominal cramps with distention and attacks of vomiting of one and one half years' duration. In November 1932 he had such an attack four hours after eating when epigastric distention developed and he vomited his meal. An enema gave some relief. In the interval between November 1932 and March 1934 he had approximately 40 such attacks usually at least once each week. Since 1918 he had taken 2 alophen tablets each night until a year before examination when he began taking agar and mineral oil. Since 1918 he had had brown watery stools three to four times a day but since changing the cathartic once a day. There was no bleeding by rectum and no vomiting of blood.

On April 16 a roentgenologic examination of the gastrointestinal tract was done. After a barium enema the films were found to be negative except for exaggerated emptying. There was no delay or dilatation except that it was noted that some barium was left in the terminal ileum.

Operation was carried out May 4, 1934, under spinal anesthesia. An obstructive lesion was found involving 7.5 cm. of the ileum and the adjacent mesentery. A V type of resection and an end-to-end anastomosis with a Furniss clamp were performed.

The pathologic report on the specimen removed was lymphoblastoma of the ileum.

The patient made a good recovery from operation and was discharged from the hospital May 28.

The patient has been examined at six month intervals since that time and no evidence of recurrence found. During the ten year period since operation he has had a small, firm, discrete, movable gland in the left axilla which has not changed. He was well, without recurrence twelve years after operation.

CASE 3—A 53 year-old white man was first seen at the clinic on May 9, 1945, complaining of epigastric distress, nausea and vomiting. He had been well until seven weeks before entry when he had had a sudden episode of nausea and vomiting. This was followed by several severe attacks of vomiting. These attacks became more frequent until finally he vomited almost immediately after the intake of any fluid or food. A roentgenologic examination before admission had shown duodenal obstruction.

Physical examination revealed that the patient was markedly dehydrated and in no acute distress. On abdominal examination there was a soft fullness in the epigastrium, suggesting stomach distention, but otherwise the physical examination was negative.

He was operated on May 15, 1945, and a primary carcinoma of the jejunum was found, about 12 cm from the ligament of Treitz, which was producing almost complete obstruction. The entire jejunum in that area along with the tumor, was densely adherent to the mesentery with several metastatic nodules in the mesentery. Resection was considered impossible and a palliative duodenojejunostomy was carried out.

Convalescence was uneventful and the patient was discharged on June 6, 1945.

CASE 4—A 51 year-old physician was first seen at the clinic on May 29,

ing continued and two years later he was again extensively studied at another medical center. Two rectal polyps were found and removed, and diverticula were found in his colon. Following this he had remained well until a year previously, when he had an attack of abdominal pain, vomiting, diarrhea and fever, and again he was studied at still another medical center. Roentgenologic examination at this time did not reveal any polyps in the colon. About this time he began to have tarry stools and anemia. The bleeding had stopped after two weeks, only to recur two months before his visit to the clinic. He had *continued to bleed since that time. Each attack of bleeding was preceded by exhaustion, nervousness, substernal distress and indigestion. These symptoms would be followed by tarry stools.*

Physical examination was negative. The hemoglobin was 67 per cent, erythrocytes numbered 4 040 000 and leukocytes 5500. The platelet count was 428 000, and the bleeding, coagulation and clot retraction studies were normal. The prothrombin was 82 per cent of normal. Vitamin C estimation was 0.38 mg per 100 cc.

Roentgenologic examination of the gastro-intestinal tract showed a small hiatus hernia and abnormal filling of the first portion of the jejunum. On fluoroscopy, there was a pooling of the barium in that region, giving the appearance of a diverticulum. This portion of the jejunum was not filled with barium on the serial films taken following the fluoroscopic examination.

A tentative diagnosis of tumor of the small bowel was made. On June 8, 1945, a right rectus incision was made under spinal anesthesia. Abdominal exploration was negative except for an area in the jejunum about 45 cm (18 inches) below the ligament of Treitz. Here, a small tumor mass about 2.5 cm in diameter was present, apparently arising from the muscularis. This was

resected removing about 20 cm of jejunum on each side of the tumor. An aseptic end-to-end anastomosis was then carried out, the appendix removed and the abdomen closed.

The pathologic report on the specimen removed was leiomyoma with mucosal ulceration. Convalescence was uneventful and the patient was discharged on June 25, 1945. He has remained well since that time, there has been no bleeding and no digestive distress.

CASE 5—A 59 year old white man was first seen at the clinic on February 19, 1946, because of loss of weight, anorexia and vomiting of four months' duration. His pain and vomiting had begun two years previously, at which time roentgenologic examination of the gastrointestinal tract had shown a duodenal



Fig 247—The deformity of the antrum of the stomach and duodenum by the external pressure of the jejunal tumor may be seen.

ulcer. An ulcer regimen had kept him well until the onset of anorexia and occasional vomiting four months previously. The vomiting had occurred every two or three weeks and the vomitus had contained recently ingested food but not blood. He had noticed tarry stools with the first episodes, but none since. His local doctor had given him iron and liver injections, without improvement. He had lost 15 pounds in weight and for the previous week had noticed marked weakness.

Physical examination was negative except for moderate pallor. No abdominal masses were palpated. A roentgenogram of the gastrointestinal tract on February 20, 1946, revealed a normal stomach except for narrowing of the antrum and the duodenum by extrinsic pressure, suggestive of a mass in the region of the head of the pancreas (Fig 247). The hemoglobin was 7.9 gm., erythrocytes numbered 3,740,000 and leukocytes 8,200.

On March 2 1946 under spinal anesthesia laparotomy revealed a normal stomach and colon but marked dilatation of the first portion of the jejunum. Approximately 20 cm from the ligament of Treitz there was a large obstructive mass extending into the base of the mesentery. Numerous polyps were present throughout the jejunum in that region. It was decided that the lesion was inoperable and a jejunojejunostomy was made proximal and distal to the tumor. A biopsy specimen was taken which showed undifferentiated carcinoma.

Following operation atelectasis developed which responded to aspiration and penicillin. Otherwise convalescence was uneventful except that the patient's appetite never returned to normal. He was discharged from the hospital on March 21 1946 and died at home on April 24 1946.

COMMENT

Case 1 illustrates how the diagnosis of small bowel tumors may be particularly difficult in the outward growing or malignant type of tumor. It also demonstrates how worthwhile radical resection may be even in the presence of metastatic nodes in the mesentery. This patient is well and without evidence of recurrence of his disease, six years following his resection for adenocarcinoma of the jejunum.

Case 2 is a patient with lymphosarcoma of the small bowel who was alive and well without recurrence, twelve years after resection of his tumor. He had had signs and symptoms of intermittent intestinal obstruction for one and one half years before his operation.

Case 3 is typical of the outward growing malignant tumors of the small bowel in which the onset of symptoms occurs so late in the course of the disease that by the time the patients are seen by a surgeon, resection is impossible. This patient had felt well until eight weeks before his operation.

Case 4 illustrates how a small bowel tumor may be responsible for
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taken at the same time. A similar case has just been reported by Marshall and Welch.

Case 5 is illustrative of the fact that in the presence of known disease in the gastrointestinal tract a second and distinct lesion elsewhere in the gastrointestinal tract may be overlooked. This patient had had abdominal pain and vomiting two years before his admission to the clinic. A roentgenogram of the gastrointestinal tract at that time had shown a duodenal ulcer, and treatment for this had kept him fairly comfortable until four months before coming to the clinic.

SUMMARY

Although small bowel tumors are uncommon, the diagnosis should be considered when examination of the stomach and colon fails to reveal a cause for abdominal pain or gastrointestinal bleeding.

Careful roentgenologic examination of the small bowel is necessary to detect these tumors in their early stages. Even when the tumor is malignant and invading the mesentery relief of the obstruction can be accomplished and at times radical resection of the bowel may achieve a cure.

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UNUSUAL LESIONS OF THE LARGE INTESTINE

RICHARD B. CATTELL AND BENTLEY P. COLCOCK

In the course of seeing a rather large number of patients with adenocarcinomas of the colon and rectum, one frequently encounters other lesions of the large intestine which must be differentiated from the usual type of carcinoma of the colon. Some of these lesions are unusual forms of malignant disease which call for radical resection just as does adenocarcinoma. Others are benign conditions for which the treatment is at times surgical, but the factors governing the type and extent of the resection differ considerably from those governing the treatment of malignant lesions. The following cases represent examples of seven different pathologic entities, four benign and three malignant, which may affect some portion of the large intestine or rectum, and for which some form of surgical treatment is indicated.

CASE REPORTS

CASE 1—A 53-year-old white man was first seen at the clinic on February 7, 1945, complaining of diarrhea which he had had for the last two years. During this time he had had at least four movements daily. He had noticed no mucus or blood in the stool until recently when he had noticed blood. Abdominal cramps had accompanied the diarrhea but he had had no nausea or vomiting. He had lost 10 pounds in weight in spite of a good appetite.

Physical examination was negative. A proctoscopic examination for a distance of 20 cm. was also negative. Serial films of the stomach and small bowel were negative except for hypermobility and motility of the small bowel. A barium enema was done and although there was poor filling of the cecum and ascending colon, there appeared to be multiple filling defects in this region (Fig. 248). The remainder of the colon was normal. Microscopic examination of the stool was negative for amebae, parasites and blood. The hemoglobin was 100 per cent, leukocyte count 13,650 and the Hinton test was negative.

The patient was admitted to the hospital for laparotomy which was carried out on June 7, 1945. Abdominal exploration gave negative results except for the cecum and ascending colon which were filled with numerous soft palpable nodules. Resection of the right colon with a side-to-side anastomosis of the terminal ileum and transverse colon was carried out.

The pathologic examination of the resected specimen revealed the mucosa of the bowel to be raised up over many confluent, tense, moderately firm nodules, varying in size from 1 to 3 cm. Each nodule was rounded, smooth and covered with intact mucous membrane. On section, the nodules consisted of an odorless, colorless gas contained in a smooth grayish blue cystic cavity.

The convalescence was uneventful and he was discharged from the hospital on June 23, 1945. He has remained well since that time and in February 1947 reported that his bowels were perfectly normal.

Cystic disease of the bowel is an unusual condition, the cause of which is not definitely known. It is thought that gas forming organisms

penetrate the submucosa of the bowel wall, and produce these gas filled submucosal blebs. It may be noted that although there was a profound alteration in bowel function, there was no intestinal bleed.



Fig. 248—The multiple circular filling defects in the cecum and ascending colon may be seen.

ing. The condition was recognized at operation, and a conservative type of local resection and primary anastomosis were carried out.

CASE 2.—A 59-year-old white man was first seen at the clinic on August 10, 1936 complaining of a loss of weight and abdominal distress. About seven weeks previously he had begun to notice a rapid loss of weight and strength. He had become pale and had begun to have marked anorexia and some nausea and vomiting. His chronic constipation had become worse. Flatulence and abdominal pains were most marked in the right lower quadrant. He had noticed tarry stools occasionally during this period. At the time of his examination he had lost 30 pounds in weight and was having palpitation and dyspnea on exertion. He had recently had a roentgenologic examination of his intestinal tract and a diagnosis of carcinoma of the ascending colon had been made. His past medical history was negative except for syphilis and he had been under treatment for the previous months.

Physical examination revealed that the patient was pale, weak and thin. Tenderness was noted in the right lower quadrant of the abdomen and the cecum was distended and palpable. He was admitted to the hospital for operation.

On August 13 laparotomy was carried out under spinal anesthesia. Abdominal exploration was negative except for a growth involving the ileocecal valve. There was an associated intussusception of the small bowel through the ileocecal valve and considerable small bowel distention. In view of these findings and the patient's generally poor condition, a two-stage resection was decided upon and an ileotransverse colostomy was carried out. The postoperative course was complicated by atelectasis and bronchopneumonia. He gradually improved and

on September 13 the second stage of the operation was performed. The right colon and terminal ileum were resected. Examination of the resected specimen showed an annular mass 6 by 5 by 3 cm arising from the region of the ileocecal valve, and projecting into the lumen of the cecum. Microscopic examination revealed it to be lymphosarcoma with extension to a lymph node.

Convalescence following the second operation was uneventful and the patient was discharged on September 27, 1936. The anemia continued, however, and he developed signs of cardiac decompensation, requiring hospitalization in November 1936. He improved somewhat, but anemia continued. In September 1937 the hemoglobin was 74 per cent and nonprotein nitrogen 39 mg per 100 cc. He was then having considerable pain in the lumbar region of his back. He died in January, 1938, probably from a recurrence of his malignancy.

Case 2 is an example of *lymphosarcoma of the cecum*. Sarcoma is an unusual lesion of the large intestine. The prognosis in this condition is not good, and the treatment should be early and radical resection. Like other forms of sarcoma, it metastasizes early by way of the blood stream in addition to invading the lymphatics, as in this case.

CASE 3—A woman, aged 47 years, first came to the clinic August 10, 1938, because of bowel symptoms. She had been constipated since childhood and for five or six years had had gas pains and belching. For two weeks there had been nausea and vomiting. She had taken laxatives at frequent intervals for a great many years.

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oil. There were generalized pains over the abdomen that were intermittent in character, and associated signs of nausea and vomiting. Flatulence was pronounced especially on retiring. There was no blood in the stools. Appetite was poor and for twelve days previous to her first examination she had taken only liquids.

On examination the patient was well developed and fairly well nourished, she weighed 135 pounds. This was only 5 pounds less than her normal weight. Her general examination was negative. There were no abdominal masses. The descending colon could be palpated and was slightly tender on deep palpation. Peristalsis was normal. The rectal and pelvic examinations were negative.

Gastric analysis demonstrated that the free acid was 18 and the total acid 60. There was no sugar in the urine. The specific gravity was 1.020, reaction was acid and there was the slightest possible trace of albumin, two to three leukocytes and many squamous epithelial cells in the urinary sediment. The hemoglobin was 75 per cent, erythrocyte count 4,230,000, and leukocyte count 6,750. The blood smear was normal and the Hinton negative.

A roentgenogram showed the kidney outlines obscured by opaque material in the colon. There was no evidence of stones. Barium entered the stomach through a normal esophagus. The stomach was normal in outline and position. Peristalsis was normal and waves passed over the sphincter. The cap filled to a good size and emptied smoothly, without defect. The third portion of the duodenum appeared dilated. In six hours a fleck of barium remained in the duodenal cap. The head of the column was entering the cecum. The tail was in the terminal ileum. In twenty-four hours the entire meal was in the right colon over

to a point of obstruction in the splenic flexure. A barium enema filled the colon almost to this point where it met definite obstruction apparently a large filling defect with obstruction at the splenic flexure. A diagnosis was made of carcinoma of the splenic flexure of the colon and operation advised.

On August 16 a left mid rectus incision was made under spinal anesthesia. Abdominal exploration was negative except for dilation and hypertrophy of the transverse colon proximal to a constricting lesion at the apex of the splenic flexure. The splenic flexure and descending colon were mobilized and a Mikulicz type of resection of the distal transverse colon, splenic flexure and descending colon was carried out with immediate decompression of the transverse colon. A transfusion was given at the conclusion of the resection.

The pathologist's report was localized subacute and chronic colitis with focal polypoid hyperplasia of mucosa and slight hyperplasia of lymph nodes.

The patient made an uneventful recovery. She was discharged from the hospital fifteen days after operation, the Mikulicz spur having been cut down by the application of a clamp.

The patient returned for closure of the colostomy, which was performed on October 19, 1939. Recovery was uneventful. She was discharged from the hospital thirteen days after closure, with the wound healed. She has remained well since that time.

Case 3 is an example of nonspecific, cicatrizing regional ulcerative colitis. We believe it is the same process which, when it involves the small bowel, is known as regional enteritis. It may affect any portion of the intestinal tract from the stomach on down, including the duodenum and colon. The etiology is unknown, and although the condition is benign, its tendency toward recurrence is well recognized. For this reason a wide excision of the bowel and its mesentery should be carried out.

CASE 4—A 39-year-old white woman was first seen at the clinic on November 8, 1937, giving a history that six weeks previously she had begun to have indigestion and abdominal discomfort most marked in the right lower quadrant of the abdomen. She had had no severe pain and no vomiting, but the dyspepsia and flatulence continued. The bowels moved regularly without the aid of cathartics and she had noticed no rectal bleeding. She was admitted to a hospital where a barium enema showed complete obstruction at the rectosigmoid. Laparotomy was performed by her local surgeon one week after the onset of her symptoms. He found a constricting annular mass in the rectosigmoid, adherent to the left broad ligament and associated with marked distention of the proximal colon. He made a diagnosis of carcinoma of the colon and performed a cecostomy. The cecostomy had drained for one week but she had noticed only a slight serous discharge since that time. She had had no other symptoms. Two years previously she had weighed 140 pounds. She had lost about 31 pounds during an illness of her only child, but recently had been gaining weight and at the time of admission she weighed 127 pounds. She had had no other serious illnesses and no previous operations.

Physical examination revealed that the patient was well nourished. There was a granulating area at the lower end of the right rectus incision and a mass

approximately 7 cm in diameter was palpable on the left side of the abdomen just above the pubis. This mass moved with displacement of the cervix on vaginal examination.

The patient was admitted to the hospital for preparation and operation. On November 12, 1937, a left rectus incision was made under spinal anesthesia. There was marked dilatation of the descending and sigmoid colon. Exploration of the abdominal cavity was otherwise negative except for the pelvis. A hard, indurated tumor was found in the sigmoid colon, densely adherent to the posterior surface of the uterus. The pelvis was filled with cystic masses arising from both ovaries. A block dissection of the pelvic viscera was carried out, including an abdominoperineal (Miles) resection of the rectum and rectosigmoid, pan-hysterectomy and bilateral salpingo-oophorectomy. The pathologic report was

well with irrigations every two days. Her wounds were healed and she was doing most of her own work.

The patient was seen a year later in August, 1938, at which time her weight was 129 pounds. She stated that her colostomy gave her no trouble, but she had an occasional slight discharge from the perineal wound. Pelvic examination was negative.

She was seen again in August, 1939. Her weight was 158 pounds and she was very active. There was no movement from her colostomy between irrigations, which were carried out every third day. There was a small granulating sinus in the perineum. Pelvic examination was negative and libido was normal. In August, 1940, she weighed 140 pounds, and reported that she was very active. In August, 1941, she weighed 169 pounds and her colostomy was functioning well. In December, 1943, she weighed 165 pounds. She had full control of her colostomy, and felt very well. She had a few menopausal symptoms, but reported her sex life as normal.

The patient was last seen on March 19, 1946, at which time she had more menopausal symptoms, being particularly troubled with hot flashes. Her colostomy was functioning well every three days, but because of some distention she was advised to carry out the irrigations every two days. Libido had decreased somewhat but she had no dyspareunia. Her weight was 162 pounds. Treatment with stilbestrol was begun.

Case 4 is an example of *endometriosis of the colon*. The clinical

history of bleeding from the bowel. The endometrial tissue invading the bowel wall rarely penetrates the mucosa. The bowel constriction is firm and unyielding. Unlike endometrial tissue elsewhere, it is not affected by bilateral oophorectomy. In this patient the process was so extensive that a block dissection of the pelvic viscera had to be carried out, including an abdominoperineal resection of the rectum and rectosigmoid.

CASE 5—A 67-year old white woman was first seen at the clinic on January 16, 1935, because of a mass in her right buttock. She had first noticed a tender mass to the right of her rectum seven weeks before. Her family doctor had incised the mass, and stated that he had found no pus, but had found a tumor. She had not lost weight.

Physical examination was negative except for a mass 5 cm in diameter in the right ischiorectal fossa. Resection of the entire area was advised and she was admitted to the hospital.

On January 22, 1935, under spinal anesthesia, a left rectus incision was made. Exploration was negative except for a spherical circumscribed tumor, 7.5 cm in diameter, arising from the outer walls of the sigmoid. There was no connection between this mass and the growth in the ischiorectal fossa. The tumor was excised and a colostomy was carried out as a first stage of an abdomino-perineal resection of the mass in the ischiorectal fossa. The second stage was carried out on February 5, 1935. The mass was widely excised with the rectum and posterior vaginal wall. The microscopic diagnosis of the tumor arising from the sigmoid was leiomyosarcoma. The lower tumor was adenocarcinoma, papillary type, arising from the rectum.

Convalescence was uneventful and the patient was discharged on March 6, 1935. She was seen again on July 15, 1935, at which time she had no symptoms referable to her abdomen, but had noticed a mass in the left axilla. This was excised on July 20, 1935, and proved to be leiomyosarcoma metastatic in a lymph node.

The patient was seen on February 20, 1936, at which time she was still active and had lost no weight. She died three months later, however, from generalized metastases.

Case 5 is an example of a *leiomyosarcoma* affecting the large intestine. *Leiomyomas* may affect any portion of the gastrointestinal tract. It is not infrequently encountered in the stomach and may represent the cause of obscure bleeding from the gastrointestinal tract when it affects the small bowel. In this patient the leiomyosarcoma of the sigmoid was associated with a carcinoma of the rectum. Once malignancy has occurred in these smooth muscle tumors radical resection is indicated, for they may metastasize early and widely, as in this patient.

CASE 6—A 42-year old white man was first seen at the clinic on January 26, 1942, complaining of a mucous discharge from the rectum and constipation. Ten years previously he had had influenza, following which he had begun to have a mucous discharge from the rectum. Since that time he had received various treatments, including diet, colonic irrigations, serum injections and so forth, none of which had affected the discharge. He had no abdominal pain and there was rarely any blood associated with the mucus. In recent years he had noticed a tendency to constipation. One of his brothers had died of chronic ulcerative colitis.

Physical examination revealed that the patient was fairly well nourished and in no acute distress. Rectal examination demonstrated large prolapsed thrombosed hemorrhoids with an atonic anal sphincter. Proctoscopic examination revealed a rigid contracted rectum covered with exudate. The wall of the lower

rectum was covered with firm, nodular granulation tissue terminating in a definite stricture 12.5 cm from the anal orifice. The appearance was that of lymphogranuloma. The hemoglobin was 76 per cent, erythrocyte count 4 800 000 and leukocyte count 7 600. A Frei test was positive. Roentgenologic examination after barium enema revealed that the colon was larger than normal.

The patient was seen again in September 1942. He had continued to have marked trouble with his bowel movements and had had to take laxatives and enemas regularly. Proctoscopic examination revealed that the sigmoid was almost closed off, and he was advised to come into the hospital for the formation of a colostomy and possible resection. Laparotomy was carried out on September 3 and the abdominal exploration was entirely negative except for the thickened indurated rectum. An abdominoperineal resection of the rectum and rectosigmoid was done.

The pathologic report on the specimen removed was chronic inflammation compatible with lymphogranuloma venereum. Convalescence was uneventful and he was discharged on September 20, 1942.

The patient was seen on October 21, 1943, at which time he had gained 20 pounds, had good control of his colostomy, was active in athletics and had been back at his work since one month following his operation.

Since the cause of *lymphogranuloma venereum* is unknown, its medical treatment is unsatisfactory. Recently some success has been reported following the use of sulfadiazine, penicillin and the injection of the Frei antigen. The involvement of the rectum in lymphogranuloma is associated with an annoying discharge of mucus and progressive narrowing of the bowel. If the obstruction becomes marked, colostomy is indicated. To relieve rectal discharge and to rehabilitate the patient an abdominoperineal resection may become necessary, as in this patient.

CASE 7—A 58 year old white woman was first seen at the clinic on December 15, 1941, with the history that five months previously she had had an injection about her rectum which had developed into an abscess. Her physician had drained the abscess but since then she had continued to have considerable rectal bleeding and pain on defecation. She had previously been constipated but recently rectal incontinence had developed so that she had to wear a rectal pad. She had lost 9 pounds in weight. She had consulted a proctologist who had taken a biopsy specimen from near the rectum; the pathologist's report was basal cell carcinoma.

Physical examination was negative except for an area of infiltration 3 to 4 cm in diameter in the rectovaginal septum and to the right of the anus. To the right of the anus was a defect resulting from the recent biopsy wound.

The patient was admitted to the hospital and on December 17, 1941, laparotomy was performed. Abdominal exploration was negative and an abdominoperineal resection was carried out. The pathologic report on the specimen removed was basal cell carcinoma with three negative lymph nodes. Convalescence was uneventful and she was discharged on January 19, 1942.

When last seen in August, 1946, her weight was constant, and the liver was not palpable. She felt well and showed no evidence of recurrence four years and nine months following resection.

Case 7 is an example of *basal cell carcinoma of the rectum*, a most unusual form of malignant disease of the large intestine. The treatment is abdominoperineal resection with particular attention to a wide excision of the perineal skin, subcutaneous tissues and perineal muscles. Any procedure less radical than a Miles resection would certainly invite recurrence in malignancy of this type and location.

RETROPERITONEAL LIPOMA

RICHARD B CATTELL AND KENNETH W WARREN

RETROPERITONEAL tumors, by virtue of their size, location and extent, frequently present confounding diagnostic possibilities and difficult surgical prob

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true nature warrants

of fatty origin are amenable to surgical treatment despite their remarkable size, their intimate visceral relationships and their malignant characteristics

These tumors tend to grow rapidly, to attain tremendous size, to become malignant and to recur locally following surgical excision. It has long seemed a physiologic paradox that these enormous fat stores could accumulate simultaneously with systemic wasting and progressive cachexia

Some general characteristics of these tumors are demonstrated by a review of the following case records of the Lahey Clinic

REPORT OF CASES

CASE 1—A woman, 55 years of age, was seen in the clinic in September 1936, complaining of paroxysmal and exertional dyspnea, cough, swelling of the ankles and precordial distress

Examination revealed the patient to be obese, with auricular fibrillation and moderate hypertension. A smooth, round mass, approximately 10 cm in diameter, was palpable in the right lower quadrant of the abdomen. A preoperative diagnosis was made of a mesenteric cyst.

At operation, a large soft mass was found in the retroperitoneal space, pushing the cecum upward and medially. It was excised without difficulty. Microscopic analysis revealed a simple lipoma. Recovery was uneventful and there was no recurrence in eighteen months.

CASE 2—A woman, 61 years of age, first came to the clinic April 1, 1940. She had experienced epigastric distress and bloating of two years' duration. For several years before the onset of these symptoms she had been conscious of a gradual increase in abdominal girth. In May 1939, exploratory laparotomy had been performed elsewhere under a presumptive diagnosis of ovarian cyst. Abdominal exploration at that time revealed the presence of a massive retroperitoneal tumor, which was not removed because of its extensiveness. A biopsy showed the tumor to be a lipoma.

Examination revealed the patient to be well developed, with a tremendous symmetrical enlargement of the abdomen. The tumor appeared to be fixed.

On April 3, 1940, a retroperitoneal lipoma weighing 28 pounds was removed. On the first postoperative day the patient had a sudden, severe pain in the left chest which persisted for several minutes. A pulmonary infarct was suspected,

and heparin was administered. The pain did not recur and recovery was not delayed. Microscopic diagnosis was lipoma.

The patient was discharged from the hospital April 24, 1940, and when seen one year later she was well and free of obvious recurrence, although she had gained 30 pounds.

She was next seen in the clinic on October 30, 1945, complaining of swelling of the abdomen and pressure distress in the upper part of the abdomen of seven months' duration. In addition she had daily swelling of the ankles, particularly on the right side.

Examination showed a massive, symmetrical swelling of the abdomen which appeared to be filled by a soft solid mass.

On December 3, 1945, a recurrent tumor weighing 38½ pounds, was removed from the retroperitoneal space. It was necessary to sacrifice the right kidney in order to remove the tumor. Convalescence was uneventful except for some abdominal cramps and diarrhea which appeared on the fourteenth day following operation. These symptoms subsided and the patient was discharged from the hospital December 28, 1945. The microscopic diagnosis was liposarcoma.

The patient was last seen on November 15, 1946, at which time there was no evidence of recurrence. Her general health was good.

CASE 3—A woman 39 years of age was seen in the clinic July 23, 1940, complaining of an abdominal tumor of eleven months' duration. The patient had experienced frequent backaches since the onset of the progressive abdominal swelling. In May 1940 an abdominal exploratory operation had been performed elsewhere with a preoperative diagnosis of ovarian cyst. No ovarian tumor was found and it was concluded that the retroperitoneal growth was a cyst of the left kidney. Two weeks later the left kidney was explored; a large lipoma was found and a specimen taken but the tumor was not removed. The tumor continued to grow and the backaches became more severe. The patient lost 8 pounds prior to her initial visit to the clinic.

Examination showed the patient to be thin and pale with a large abdomen. A large mass filled most of the abdomen and extended into the pelvis. The tumor was nodular and filled the left flank.

On August 13, 1940, the abdomen was explored and a massive retroperitoneal tumor was observed pushing the small intestine and ascending colon to the right. The transverse and descending colon ran along the left lateral border of the tumor. The growth was attached to the left kidney which was deliberately removed. The removed specimen, which was a lipoma of primitive cell type, weighed 20 pounds. Recovery was without incident.

In October 1942 the patient returned because of an abdominal mass which upon examination proved to be a fibroid uterus. Hysterectomy was performed October 15, 1942. There was no evidence of recurrence of the lipoma at that time.

On September 22, 1944, radical mastectomy was done for carcinoma of the breast. Recent examination showed no signs of recurrence of either growth.

CASE 4—A woman planning of statulent duration. The presence of these symptoms has been known since the onset of the disease. The patient was a known diabetic under adequate insulin control.

Physical examination revealed that the patient was well nourished. The veins were moderately distended over the abdominal wall. There was a large mass in the mid abdomen extending into the left flank. Intravenous pyelograms demonstrated displacement of the left kidney upward and outward. The left ureter was not visualized. The preoperative diagnosis was a tumor of the left kidney.

At operation, April 23, 1945, a large retroperitoneal tumor extending from the pelvis to the spleen was excised. The descending colon and sigmoid ran over the growth. The left ureter traversed the mass and was sacrificed necessitating removal of the left kidney.

Pathologic examination revealed a liposarcoma with a focus of bone formation.

On the seventh postoperative day the patient had an insulin reaction, followed by left hemiplegia and coma. Death ensued four days later.

Autopsy showed a gangrenous segment of small bowel secondary to a constricting band. Fragments of the liposarcoma remained in the retroperitoneal space.

CASE 5—A man 64 years of age was observed in the clinic on February 8, 1946, complaining of a lump in the right side of the scrotum of one year's duration. The mass first appeared in the right groin from whence it gradually grew into the right side of the scrotum. There were no attendant symptoms.

Examination revealed a firm mass extending from the right inguinal ligament to the umbilicus. It appeared to be continuous with a similar mass in the scrotum. The testis was palpable but was connected with the growth. A clinical diagnosis was made of a fibrosarcoma of the right groin.

On March 1, 1946, a preperitoneal lipomyosarcoma weighing 950 gm was excised, along with the right testis. The postoperative course was devoid of incident and he was discharged from the hospital on March 17, 1946. He was seen on October 23, 1946, at which time he was free of obvious recurrence.

COMMENT

Physical and chemical analyses have failed to reveal differences in lipomatous and normal tissue fat which might account for the apparent unavailability of tumor fat for nutritional purposes. Hirsch and Wells reported the results of extensive chemical analyses of a huge retroperitoneal liposarcoma. They found that the tumor did not contain as much fat as the gross specimen suggested. Nevertheless, there was a significant amount of fat in a tumor of a patient showing extreme emaciation.

Ewing assumes that "local conditions possibly the character of the circulation, prevent the absorption of the lipoma in these instances."

Lipomas are more common in the female and are observed most frequently in patients between the ages of 40 and 60 years. They grow slowly and commonly attain considerable size before their presence is detected by the host. Even then, the symptoms are usually minimal and are related to mechanical inconvenience. The largest tumor on record, weighing 69 pounds, was reported by Hirsch and Wells, and it was not removed surgically.

McConnell excised a retroperitoneal lipoma which weighed 65

pounds. The tumor recurred six and one half years later, and the recurrent growth, weighing 27 pounds, was removed.

Mayo and Dixon reported three cases in 1927, in which the tumors weighed 175, 185 and 35 pounds, respectively. McLaughlin and Sharpe reported 2 cases, one of which exhibited a tumor at autopsy, weighing 56 pounds.

These growths arise most frequently in the para-vertebral or perirenal fat, but they may occur at any point in the abdomen or pelvis. They may originate in the thigh and gain access to the retroperitoneal space through the femoral or obturator canal. Not infrequently, they invade the mesentery of the ileum and surround the kidney.

These tumors show a marked tendency toward malignant degeneration and recur not infrequently in sarcomatous form even though the original tumor was apparently benign. It should be remembered in this regard that many of these tumors are extremely large and that failure to detect malignant areas may result from faulty sampling of the removed specimen. A rapid alteration in the progression of these tumors is highly suggestive of malignant disease and is usually accompanied by myxomatous degeneration. Hertzler concluded that "retroperitoneal lipomata represent a very embryonal type of tissue, and that rapid growth myxoid and sarcomatous admixture are but manifestations of a primary impulse."

The tumors exhibit in their malignant states a variety of histologic types, including lipomyxosarcoma, lipofibrosarcoma and true liposarcoma. One tumor observed at the clinic showed an area of bone formation which according to Ewing probably results from an area of necrosis followed by calcification and ossification.

Perirenal lipomas which account for a considerable portion of all retroperitoneal tumors of fatty origin, according to Hunt and Simon may arise from the renal capsule or perirenal tissue. Some are multilobular, others cystic and many contain areas of sarcomatous degeneration. They may encompass the kidney and compress its blood supply to cause atrophy.

Histologically they are essentially connective tissue tumors containing to some extent areas of sarcomatous degeneration.

SYMPTOMS

The symptoms although variable are generally meager and include swelling of the abdomen and the presence of an abdominal mass. Not infrequently, the growth reaches a considerable size without knowledge of the host. Vague pressure manifestations and mild gastrointestinal disorders are common in those instances in which the tumor is of sufficient size to compress or displace adjacent viscera. Severe symptoms are rare and include dyspnea, ascites, edema and persistent

nausea and vomiting Pfeiffer and Gaudin reported a case in which marked compression of the vena cava was observed

With the advent of malignant degeneration, fatigue, loss of weight, anorexia and wasting occur Urinary symptoms are rare, but may result from ureteral obstruction because of pressure Acute symptoms such as severe pain, fever, tenderness, nausea and vomiting are rare and indicate a focus of degeneration or the mechanical embarrassment of adjacent abdominal viscera

In the series from the clinic, the symptoms of abdominal pain, flatulence, anorexia and edema of the ankles were those most commonly observed Only 3 patients complained of abdominal tumor, and one had backache

DIAGNOSIS

The clinical recognition of these tumors is not easy but their presence should be suspected in an adult, particularly a woman, who gives a story of vague abdominal pressure, associated with a slow growing abdominal mass of considerable size in whom visceral disease is evidently absent The tumor is of soft solid consistency, relatively fixed and tends to fill the abdominal cavity The roentgenographic demonstration of an elevated diaphragm and the pyelographic delineation of a displaced kidney are valuable corroborative evidences of retroperitoneal tumors Roentgenologic studies after a barium enema may show the bowel to be displaced anteriorly and medially

Differential diagnosis must comprehend ovarian cyst pancreatic and mesenteric cysts, retroperitoneal and intra abdominal malignant disease, ascites, cirrhosis, splenomegaly and pregnancy The specific elimination of these possibilities suggests strongly the presence of a retroperitoneal tumor

TREATMENT

Most retroperitoneal lipomas are amenable to surgery, and every effort should be made to excise the growth completely They are thinly encapsulated and it is often necessary to remove them piecemeal They frequently encircle the kidney and occasionally invade its parenchyma, necessitating nephrectomy Exquisite care to avoid injury to the great vessels and retroperitoneal viscera should be exercised in every instance

The transperitoneal approach through a generous incision, with the patient under spinal anesthesia, affords the safest access to these tumors The lumbar approach does not permit sufficient exposure of the mesentery of the bowel and the retroperitoneal structures A transverse abdominal incision would be satisfactory

The hazards of surgical excision are considerable and the mortality varies from 20 to 25 per cent This mortality relates to the enormous size of the tumors, their intimacy with the great vessels and retroperitoneal viscera, and results primarily from hemorrhage and

shock. Delayed postoperative complications, which contribute materially to the high mortality, include ileus peritonitis, gangrene of the bowel, pneumonia and pulmonary embolism. Consequently, energetic measures directed toward the prevention of these complications must be pursued in every instance.

PROGNOSIS

Without treatment the growth of these tumors leads slowly to death. Following excision, recurrence is common and malignant degeneration is frequent, but it is possible in many instances to excise the recurrent growth and extend life significantly.

The effectiveness of irradiation is doubtful. Stewart and Selman believe it is beneficial while Rheback and Houser, Barnard and McLaughlin and Sharpe believe that it is of little value. The surgical excision of recurrent tumors is usually justifiable because of the slow growing nature of the lesion. Irradiation may be employed in those cases proven inoperable by thorough exploratory operation.

In this series of 5 patients who were subjected to six operations for retroperitoneal lipomas, there was one death. This patient, a diabetic, had an insulin reaction on the seventh postoperative day and died four days later from mesenteric thrombosis and paraplegia.

Of the 4 survivors, one whose original tumor weighed 28½ pounds had a recurrence five years later. The recurrent tumor, a lipomyxosarcoma weighing 38½ pounds, was removed successfully but with the sacrifice of the right kidney. The patient had no evidence of recurrence at the end of one year.

Another individual survived an excision of a primitive cell type of lipoma which weighed 20 pounds. Two years later she submitted to hysterectomy and four years following the original operation she had a radical mastectomy for carcinoma. She is well at present.

The 2 remaining survivors were well and free from recurrence eighteen months following operation. One of these individuals had a malignant tumor.

SUMMARY AND CONCLUSIONS

Retroperitoneal lipomas may attain enormous size attended by meager symptoms.

They are prone to malignant degeneration and are given to local recurrence following surgical excision.

Despite these characteristics these tumors warrant vigorous surgical attack.

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MESENTERIC TUMORS

HERBERT D. ADAMS

TUMORS that involve the mesentery comprise a wide variety of both common and relatively rare types. Because of this diversity and the nature of these tumors, their surgical significance and management likewise, cannot be standardized. A rough clinical classification of these tumors is presented, however, with a few cases to illustrate the surgical problems involved in their management.

mass in the abdomen or its presence is discovered on routine examination. Occasionally, however, they will reach such a size as to produce extrinsic pressure on adjacent organs, thereby producing symptoms of interference of the function of these organs. The common asymptomatic tumors discovered inadvertently in this manner are the mesenteric cysts, lipomas, myxomas, leiomyomas, fibromas and ganglioneuromas. Simple excision, using extreme care not to destroy any adherent essential blood supply to the bowel, and very careful closure of the peritoneal surfaces of both sides of the mesentery in order to prevent herniation and obstructing adhesions of other loops of the small bowel are the technical factors of importance in the management of the mesentery. Occasionally such a size that it involves and may produce distortion, compression and obstructive symptoms, and this portion of the bowel must be resected even though the lesion is benign, and a very careful end-to-end or side to side anastomosis done. Case 1 illustrates this type of surgical management.

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The general examination was essentially negative except for the abdominal examination which revealed a firm round smooth nontender movable mass filling the lower and midabdomen and showing considerable mobility in that it could be pushed into almost any quadrant of the abdominal cavity. Roentgenograms, including a complete gastrointestinal study were not contributory. A diagnosis of mesenteric cyst was made preoperatively but at operation a large rounded, solid tumor, approximately 23 cm. in diameter was found in the mesentery of the jejunum. Because of its size the blood supply to the jejunum in this region was extensively involved as was the mesenteric border of the bowel wall itself, although there was no definite invasion of the bowel. Approximately 2

feet of jejunum with the mass and adjacent mesentery was resected and the continuity of the jejunum reestablished by an end-to-end anastomosis.

The pathologic report showed 69 cm of small intestine with the mesentery. The root of the mesentery, as well as the muscular layers of the loop merged into a huge spheroid mass 18 by 18 by 11 cm. The total weight was 1840 gm. The mass was encapsulated. The microscopic diagnosis was fibroma.

Following operation, the patient made an uneventful convalescence and her follow up shows that she has had no recurrence and is at the present time symptom free.

The most common tumors of the mesentery are *metastases or extensions from malignant lesions* arising from almost any of the abdominal viscera. Therefore, any type of malignancy common to the various abdominal viscera may be found in the mesentery. Although seen with great frequency, these lesions are of little clinical or therapeutic significance since they are usually discovered during an exploration for the primary lesion. Their presence usually determines that the primary lesion is inoperable and a biopsy specimen is taken to obtain pathologic confirmation of this fact.

The other fairly common forms of malignant tumors involving the mesentery are the *sarcomas*. The most common of these are the malignant lymphomas, Hodgkin's disease and the lymphosarcomas, but patients with other types of sarcomas such as fibrosarcoma, leiomyosarcoma and rhabdomyosarcoma have been operated upon in this clinic. These patients usually give a history at the onset of rather vague abdominal pain or distress not associated with any significant symptoms related to the various abdominal systems. Studies are practically always negative at this stage, and in the early months these patients are likely to be branded as hypochondriacs and their symptoms classified as psychosomatic. Later on, however, as the disease progresses, in addition to the persistent pain, general debility becomes evident, and a mass may then become palpable or be vaguely outlined by the roentgenogram either as a soft tissue shadow or by an abnormal displacement of abdominal viscera. Abdominal exploration is then carried out and usually extensive involvement of the mesentery and retroperitoneal tissues is found. In most instances the sarcoma is extensive and intimately involves a greater part of the major blood vessels passing through the mesentery to the bowel, and, therefore, cannot be resected. A biopsy specimen is taken to establish the classification. Usually these tumors are radiosensitive and a course of x ray therapy is given following the exploration. The prognosis in these retroperitoneal sarcomas is extremely poor as is the case with sarcoma in general. One of the rare types of sarcoma involving the mesentery is illustrated in Case 2.

CASE 2—A 46-year-old man gave a history of vague abdominal distress. He had had a complete roentgenologic examination, including intravenous pyelograms and gastrointestinal studies, two months before admission, all of the

studies were negative. At the time of admission he had become conscious of a fullness and a feeling of a mass in his midabdomen. He had lost about 10 pounds in weight and considerable strength and very recently had noticed some swelling of his ankles by the end of the day.

The general examination was essentially negative except for the abdominal examination which showed a deep seated somewhat tender mass just to the left of the umbilicus and in the lower epigastrium. A preoperative diagnosis was made of carcinoma of the pancreas.

On exploration a very large, irregular, hard mass was found filling the mesentery and extending into the retroperitoneal tissues from the level of the transverse mesocolon to the brim of the pelvis. This intimately involved the superior mesenteric vessels and the mesentery vessels to the left colon. It was obviously inoperable and a biopsy specimen was taken. The pathologic report was a rhabdomyosarcoma.

The patient made a satisfactory recovery following the exploration and was given a course of deep x ray therapy but his condition steadily became worse.

Several extremely rare types of malignant tumors involving the mesentery have been encountered and are reported because they illustrate the value of both palliative and radical surgery in these cases.

CASE 3—An unmarried woman of 54 gave a history of indefinite abdominal distress of three or four years duration. She had had a cholecystectomy three years before being admitted to the clinic. At the time she was first seen at the clinic she was still having vague abdominal distress and stated that she had noted a mass in her abdomen of at least two years duration. Examination at that time was essentially negative except for the abdomen which showed a very large, hard, fixed mass throughout the central part of the abdomen.

An abdominal exploration was done which revealed a huge mass throughout the mesentery of the small bowel and extending to the bowel margin along the terminal ileum and at the cecum although there was no direct invasion of these loops. There were also numerous nodules in the liver. Since the tumor was definitely inoperable and obstruction of the terminal ileum was imminent, an ileotransverse colostomy was done and a biopsy specimen taken. The pathologic diagnosis was *carcinoid*. Following this she made a good recovery and earned on an active existence relatively symptom free for a period of five more years, a total history of eight years duration.

This case illustrates unusually well the value of a palliative procedure when radical removal of the mesenteric tumor could not be done.

A second unusual case is also presented to illustrate in contrast that radical surgery is possible in some of these cases of advanced malignancies involving the mesentery.

CASE 4—A man of 62 years came to the clinic complaining that for the last year he had had dull, abdominal pain and distress and vague gastrointestinal symptoms. He had no particular loss of strength or weight.

Examination showed that the patient was obese and in fairly good condition. The abdominal examination showed a large rounded mass in the midabdomen.

A tentative diagnosis of pancreatic cyst was made. Roentgenologic studies were not contributory and an abdominal exploration was carried out.

At operation a large tumor mass was found to occupy the entire midabdomen, arising from the mesentery of the small intestine. Several loops of small intestine were densely adherent to the tumor and the blood supply of the terminal ileum and cecum was so involved that it was necessary to resect about 2 feet of terminal ileum, the cecum and ascending colon. A Mikulicz type of resection, ileum to transverse colon, was done.

The pathologic examination showed 60 cm of terminal ileum with the cecum and ascending colon, to which was attached the mesentery involved by a large encapsulated mass weighing 910 gm and measuring 26 by 28 by 9 cm. The external surface presented many nodules and a variety of colors from white to yellow to red. Serial sectioning revealed large cystic areas containing brown thin fluid and much stringy, necrotic material. Elsewhere the tissue was firm and white, in other regions soft and yellow. The microscopic diagnosis was undifferentiated malignant tumor suggesting a mixed tumor of Wilms' type arising from the urogenital ridge; the intestine was negative.

Following operation the patient made an uneventful convalescence and returned later to have his Mikulicz colostomy closed. Because of the highly undifferentiated type and extent of the tumor he was given supplementary treatment with deep x ray therapy and at the present time is well and symptom free.

It is evident from this case that even some of the more extensive mesenteric tumors can be resected, but in most instances the blood supply to a certain part of the bowel is usually so involved that resection becomes necessary.

In summary, mesenteric tumors comprise a very wide range of tumors, both benign and malignant. The latter tumors, exclusive of metastatic carcinoma primary in other abdominal viscera, are usually sarcomas of a highly malignant type and with extremely poor prognosis. In the benign tumors, excision can be accomplished readily with good results. In the malignant tumors, x ray therapy, palliative surgical procedures and, rarely, an extensive resection are possible.

PROGNOSIS OF PATIENTS WITH CARCINOMA OF THE COLON, RECTOSIGMOID AND RECTUM

FRANK H LAHEY

WHILE it is largely of academic interest when a patient presents himself with a carcinoma of the colon to deduce from the history and the roentgenograms the probable operability or inoperability of the lesion, it nevertheless has some value

As we have repeatedly stated, the diagnosis of carcinoma of the colon and rectum can usually be made from the history, such as the presence of blood in the stools, the presence of obstructive pain, the presence of alteration of bowel function, and change in caliber of the stools. We have shown that one of these four features of this disease is present in all but 23 per cent of the histories as we see them, and it is from this evidence together with the roentgenologic evidence of the disease that one can often make quite an accurate prognosis as to the extent of the lesion, its degree of operability and its likelihood of recurrence. When any one of these four symptoms has been present in the history for a period of months it is reasonable to assume that the lesion is late and when it is late that it will fall into the group of less favorable cases.

When, for instance, a patient who has had a history of normal bowel movements over the years reports that for a period of six months there has been an alteration in his bowel function, either constipation which has changed to diarrhea or normal bowel movements which have changed to constipation or alternating diarrhea and constipation for a period of months obviously the case falls into the unfavorable group. When bleeding which can be demonstrated not to be caused by bleeding hemorrhoids has been present for months it is obvious that the lesion has existed for a long period of time and this type of patient likewise falls into the unfavorable group. When the caliber of the stools has changed and when obstructive symptoms occur, and these are due to a demonstrated narrowing of the rectum or colon by an obviously malignant lesion it must be assumed that the lesion is late. This assumption is based upon the fact that any lesion which has completely surrounded the colon to such a degree that it produces obstructive symptoms or a narrowing of the stools is obviously a late lesion at least six months old.

These factors discussed above can even further be demonstrated in the roentgenograms of the lesion. There are two features to the roentgenologic pictures of a carcinoma of the rectum or colon from which one may deduce its operability and whether or not it falls into a favorable or an unfavorable group—annularity and canalization.

When it is realized that most all of the lesions of the colon and rectum start either from a polyp or an adenoma, and even though this be not admitted, start from one point in the circumference of the colon, it can be appreciated that when the malignant disease has spread from one point on the colon wall to surround it completely



Fig 249—This illustration demonstrates not only annularity but canalization between the two points marked by arrows

this spread has consumed a period of time, the minimum of which is six months. This is the feature which I have described as annularity and when present indicates that the lesion is not an early one.

When, in addition, as can be shown by the roentgenogram, a carcinoma of the colon and rectum has not only become annular, completely surrounding the bowel, but has canalized that structure by

growing along it, it can then be assumed that the lesion is somewhere



Fig 250.—This illustration demonstrates advanced annularity and canalization. It must be obvious that for the growth to have extended along the bowel this distance, it must have existed for a long period of time

rate. It is these two features, length of history and character of the roentgenogram, that I wish to call attention to with regard to their value in prognosis

It would be wrong to discuss prognosis in relation to these two features without energetically stressing that even though there be a long

history of blood in the stools, alteration in bowel function, together with the presence of pain of an obstructive character and tape like stools and in addition annularity and canalization as demonstrable by the roentgenograms, it should not be assumed that the lesions are inoperable.

We have now had such a large and varied experience in operating upon patients with carcinoma of the colon and rectum that we know that these lesions act in unpredictable ways. In small and early lesions of the rectum, palpable on digital examination as small lesions and very movable, we are frequently surprised to find early involvement of the liver by metastases. On the other hand, in late lesions, large and fixed, we are likewise frequently surprised to find relatively few glands, and no involvement of the liver. It is for these reasons that I wish to state that the length of the history plus annularity or canalization in the roentgenogram should by no means discourage any one from exploring these cases as to operability.

There is another feature with which we have had experience as relates to prognosis to which I wish to call attention, and that is the fact that lesions of the right colon can produce such changes in patients' appearance as to make them appear as patients with probably inoperable lesions. It has been demonstrated over a great many years that in approximately one fourth of the patients with carcinoma of the right colon, unexplained degrees of secondary anemia will be of such

the lesion was removable and to have them go a great many years with no evidence of recurrence.

I have repeatedly stated in discussing these lesions of the right colon that if the same degree of cachexia were present in a lesion of the left colon as can be present in a lesion of the right colon, the patient in a great majority of the cases would be found to have an inoperable lesion.

It is because of the unexplained secondary anemias that are associated with lesions of the right colon that I particularly wish to call attention to the fact that carcinomas of the right colon can cause appearances in patients which if the carcinoma were present in the left colon would indicate almost with certainty inoperability but in the right colon are by no means of such significance.

CONCLUSIONS

Attention is directed toward the employment of the length of time of features associated with carcinoma of the colon and rectum, such as alteration in bowel function, obstructive pain, change in caliber in the stools and the presence of blood, to determine the prognosis.

Attention is also called to the fact that degrees of secondary anemia

and apparent inoperability can be present in lesions of the right colon and still the lesions found to be readily operable with five year non recurrence rates of gratifying percentages

Attention is also called to annularity and canalization as shown by the roentgenogram in carcinomas of the colon and rectum as an indication of the lateness of the lesion

The fact is stressed that these are of interest only in prophesying for one's own benefit operability and should never lead one to be discouraged in exploring these cases because of the unpredictability of rapidity of growth and metastatic involvement which go so consistently with carcinoma of the colon and rectum

THE SIGNIFICANCE OF MUCOSAL POLYPS OF THE COLON AND RECTUM

NEIL W. SWINTON

of the colon and rectum

In 1939 a study³ was

with benign and malign

nant polyps of the colon and rectum from which certain conclusions were drawn (1) Polyps in the lower bowel are true tumors owing to some inherent defect in cellular growth, and are not the result of inflammatory processes (2) In this series, all stages in the sequence of change from normal mucosa through an adenomatous polyp to adenocarcinoma were demonstrated histologically (3) In a series of 827 cases of cancer of the colon and rectum, the carcinoma was demonstrated to have arisen from preexisting benign mucosal polyps in 14 per cent It was believed that a much higher incidence of cancer in this region arose in preexisting benign polyps

Additional articles have appeared in the literature both prior to and subsequent to this report, confirming these views, and it is now generally recognized that benign mucosal polyps of the colon and rectum are true tumors and definite premalignant lesions

During the past decade many advances have been made in the treatment of cancer of the colon and rectum At the present time a resectability rate of from 80 to 90 per cent operative mortality under 10 per cent and five-year survival rates of 50 per cent and over are being reported from many centers in this country where there has been particular interest in this field In 1945 at the clinic, 178 patients were seen with cancer of the colon and rectum Ninety per cent had some type of radical resection, with an operative mortality of 7 per cent At the present time the five-year survival rate for malignant disease of the colon is 53 per cent and of the rectum 46 per cent.

It is disturbing, however, in reviewing our experience, to find that the early diagnosis of cancer of the colon and rectum is not being made as frequently as it should be in many instances, and that sufficient emphasis has not been given to the important part that benign colon and rectal polyps play in the development of this lesion

Since the publication of our report³ on colon and rectal polyps in 1939, several hundred additional patients with polyps in this region have been seen at the clinic and additional data have been obtained concerning these lesions

In a study based on the 1843 autopsies performed between 1935 and 1945 in the pathologic laboratory of the New England Deaconess Hospital, Haug² found an incidence of benign colon and rectal polyps

of 7 per cent in patients dying from all causes Helwig has recently reported an incidence of 9.5 per cent in a series of 1460 consecutive autopsies Both reports reveal an increasing incidence of benign tumors with age particularly after the third decade

If an increasing number of patients with cancer of the colon and rectum are to be submitted to operation earlier than has been the case in the past of cancer in benign rectal tumors must be given to the fact that these tumors occur much more frequently than previously was suspected and every effort must be made to discover them at the earliest possible moment and to remove them before they become malignant.

TABLE 1

INCIDENCE BY LOCATION OF BENIGN POLYPS AND MALIGNANCIES OF THE COLON

Location	Malignancy		Benign Polyps	
	Cases	Per cent	Cases	Per cent
Cecum	27	13.0	84	20.5
Ascending colon				
Hepatic flexure	28	13.5	85	27.3
Transverse colon				
Splenic flexure	152	73.5	182	52.2
Descending colon				
Sigmoid				
Rectum				
Anus	207		311	
Total				

If large numbers of benign colon and rectal polyps are to be found in the adult population it will not be sufficient to depend on the few highly trained surgeons in this field All physicians internists as well as surgeons doing any type of general diagnostic work, must be aware of the significance of these tumors their frequency and be prepared to search for them at every provocation

In 1943 the Bureau of Vital Statistics reported that approximately 168,000 people died of malignant disease in the United States This number had increased to over 190,000 in 1948 Of this number approximately 8 per cent died of cancer of the terminal bowel The importance of prevention of colon and rectal cancer can easily be appreciated by the magnitude of these figures

In the study reported by Haug,² certain additional facts concerning these premalignant lesions are worthy of further emphasis (1) Of the 1843 consecutive autopsies studied, benign polyps were found in 130 cases, or 7 per cent (2) Of these 130 cases, 55, or 41 per cent, had two or more polyps, whereas 59 per cent had single lesions (3) The location of these tumors compared to the location in the 195 patients with 207 large bowel malignancies found in the same series is shown in Table 1 (4) Fifty, or 25.1 per cent, of the patients with carcinoma of the colon or rectum had associated benign polyps (5) A comparison of the sex and age factors in the two groups, benign and malignant, is shown in Table 2

TABLE 2

INCIDENCE BY AGE GROUPS AND SEX OF PATIENTS WITH BENIGN POLYPS AND MALIGNANCIES OF THE COLON

Malignancy				Benign Polyps		
Decade	Males	Females	Total	Males	Females	Total
21-30	2	0	2	1	0	1
31-40	6	2	8	2	1	3
41-50	10	16	26	8	4	12
51-60	30	23	53	18	15	33
61-70	41	30	71	35	17	52
71-80 plus	23	15	38	21	12	33
Total	112	80	198	85	49	134

Incidence by Sex

Benign polyps	85 males	or 63.4% of 134 patients
	49 females	or 36.6% of 134 patients
Malignancy	112 males	or 56.5% of 198 patients
	86 females	or 43.4% of 198 patients

THE DETECTION OF BENIGN POLYPS OF THE COLON AND RECTUM

The common symptom associated with colon and rectal mucosal polyps is bleeding. A few will remain benign and yet attain sufficient size to cause obstructive symptoms or an alteration in bowel function. In our experience, considerably less than one-half of the patients in whom benign colon and rectal polyps are discovered will have any symptoms referable to the polyp when it is in a benign state. Just as approximately 70 per cent of all malignant tumors of the colon and rectum are within reach of the 10-inch sigmoidoscope, so over 50 per cent of the benign colon and rectal polyps are found in this same region of the terminal bowel. As our indications for careful sigmoidoscopic examinations have increased, the incidence of benign

colon and rectal polyps which we have discovered has likewise increased. Not only should all patients who present abnormal stools, any alteration in bowel function, unexplained abdominal pain, unexplained abdominal tumor or anemia, which symptoms suggest malignant disease of the large bowel, be submitted to sigmoidoscopic examination, but whenever possible a careful sigmoidoscopic examination should be made of all patients, particularly those beyond the third decade, as a part of a complete general examination.

Sigmoidoscopic equipment is not expensive and it should be as important a part of the physician's armamentarium as a stethoscope. In many thousands of sigmoidoscopic examinations at the clinic, no serious injury has ever resulted from the use of a sigmoidoscope. Although the procedure can be time consuming and not a particularly pleasant experience for many patients to undergo, it is a valuable

method of examination or direct examination of the colon at the time of operation. The detection of colon polyps in this region depends largely on the use of the contrast air enema technic. This is a time consuming and not too satisfactory a procedure. Careful preparation of the colon by means of a castor oil cathartic, a low residue diet, and careful colonic irrigations must precede a contrast air enema and the examination carried out by an experienced radiologist. The number of benign colon polyps discovered in this manner by radiologic methods is much less than the known incidence of tumors in this region. It is the best technic now available, but it is recognized that only a small percentage of the polyps in the right and transverse colon particularly is being detected by this method. Certainly, whenever an abdomen is opened careful inspection and palpation of the entire large bowel must be made routinely. It is to be hoped that further advances in this field can be made in the near future for the detection of tumors that cannot be observed by the sigmoidoscope.

The importance of the high incidence of the multiplicity of these tumors must be appreciated. Forty one per cent of the patients in the previously mentioned series had two or more polyps. This indicates that when one polyp is found, every means must be taken to search for additional polyps.

Four per cent of the patients in this series with malignant disease of the colon and rectum had multiple cancers. This is probably explained in part at least by the frequent occurrence of multiple benign tumors.

When operating for cancer of the colon or rectum, it must be appreciated that 25 per cent of patients with malignant tumors may have associated benign lesions. So commonly, surgeons have had the experi-

colon and rectal polyps which we have discovered has likewise increased. Not only should all patients who present abnormal stools, any alteration in bowel function, unexplained abdominal pain, unexplained abdominal tumor or anemia, which symptoms suggest malignant disease of the large bowel, be submitted to sigmoidoscopic examination, but whenever possible a careful sigmoidoscopic examination should be made of all patients particularly those beyond the third decade, as a part of a complete general examination.

Sigmoidoscopic equipment is not expensive and it should be as important a part of the physician's armamentarium as a stethoscope. In many thousands of sigmoidoscopic examinations at the clinic, no serious injury has ever resulted from the use of a sigmoidoscope. Although the procedure can be time consuming and not a particularly pleasant experience for many patients to undergo, the end result in finding an increasing number of premalignant tumors in these patients has more than justified the effort expended.

The detection of large bowel polyps above the reach of the 10 inch sigmoidoscope is more difficult. Dependence must be placed on radiologic examination or direct examination of the colon at the time of operation. The detection of colon polyps in this region depends largely on the use of the contrast air enema technic. This is a time consuming and not too satisfactory a procedure. Careful preparation of the colon by means of a castor oil cathartic, a low residue diet, and careful colonic irrigations must precede a contrast air enema and the examina-

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When operating for cancer of the colon or rectum, it must be appreciated that 25 per cent of patients with malignant tumors may have associated benign lesions. So commonly, surgeons have had the exper-

ence of successfully removing a malignant tumor in this region only to have the patient return years later with an entirely separate lesion. Every effort preoperatively at the time of operation and postoperatively must be made in these cases to find polyps which might give rise subsequently to a malignant tumor.

THE DETERMINATION OF MALIGNANCY IN COLON AND RECTAL POLYPS

In cases in which the rectal polyps are within reach of the examining finger too much emphasis cannot be placed on the palpation of these tumors in differentiating malignancy. Fixation, ulceration, induration and firmness are diagnostic of malignancy to the experienced observer in the majority of cases. It is advisable to perform a biopsy in all cases of suspected malignancy but when the microscopic report does not verify the clinical impression the patient must still be considered to have a malignancy until it is proved beyond any question of a doubt that the tumor is not cancer. Malignancy may develop in any portion of a benign mucosal polyp. In this discussion polyps have been defined as sessile or pedunculated benign tumors of glandular tissue.

tumor and its base. Repeated biopsies may be necessary particularly in some of the larger tumors before cancer tissue will be encountered.

THE TREATMENT OF COLON AND RECTAL POLYPS

Benign colon and rectal polyps within reach of the 10 inch sigmoidoscope may be removed safely either by direct fulguration or when there is a definite pedicle by the high frequency electric snare. Care must be exercised to avoid perforation of the bowel above the peritoneal reflection and also to avoid troublesome hemorrhage which may arise from the artery so frequently encountered in the stalk of the larger polyps. All but the very large benign polyps or those tumors above the peritoneal reflection may be removed as an office procedure. Adequate sigmoidoscopic equipment, biopsy forceps, dependable suction apparatus for the removal of air and fluid, and a cautery must be available.

For those polyps in which early carcinomatous changes are found serious consideration must be given to the method of treatment advised.

In the pedunculated polyp with a definite pedicle and early malignant change in which it can be demonstrated beyond any question of a doubt that there has been no extension of the malignant process into the pedicle or bowel wall local excision may be adequate. There is at the clinic an appreciable series of cases of this type without evidence of recurrence which have been followed very carefully over a

period of years after local removal. This series of cases is being reported in detail at a later date. It must be constantly borne in mind, however, that the treatment of cancer of the colon and rectum is radical resection and it has been our policy that the earlier the lesion the more radical the approach.

SUBSEQUENT OBSERVATION OF PATIENTS WHO HAVE HAD BENIGN COLON OR RECTAL POLYPS

It has been demonstrated that the same inherent growth factors which apparently cause the development of malignant disease cause the formation of the benign but definitely premalignant tumors of the colon and rectum particularly with advancing years. Therefore, not only should patients who have been found to have colon and rectal polyps be carefully studied for the presence of additional polyps, but over the years they should be followed for the development of additional polyps.

CONCLUSION

A physician recently visiting the clinic who has a large general practice in a small community, informed us that he had been particularly interested in the problem of rectal and colon polyps. He was aware of their frequency and premalignant nature, and during the past several years had carried out a sigmoidoscopic examination of nearly every patient who came to him for a physical examination. He had discovered a large number of patients over the years with benign colon and rectal polyps. He estimated that this figure represented 5 per cent seen during this time. Certainly, this attitude represents what should be done by a large number of physicians if we are to make the most effective use of our present knowledge concerning colon and rectal polyps and their relation to colon and rectal cancer.

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CANCER OF THE OVARY

NEIL W SWINTON AND CHARLES R YANCEY

MALIGNANT tumors of the ovary comprise approximately 4 per cent^a of malignant disease found in women. Eighty nine patients with ovarian malignancy have been seen at the clinic during the past fifteen years. A review of these cases at this time reveals that frequently a diagnosis of cancer was not made before operation and even at operation in certain cases the presence of malignancy was not suspected.

In an attempt to make earlier diagnoses of ovarian malignant disease, obtain data on potentially malignant ovarian tumors, further information on the detection of malignant change in these tumors at the time of operation and to determine the type of treatment indicated when ovarian cancer is encountered, we have reviewed the 64 cases of ovarian cancer in which we have complete data at this time and also have reviewed the recent literature on the subject.

TABLE 1
INCIDENCE OF VARIOUS TUMORS IN 1101 CASES
(After Bernstein¹)

	Per cent
Follicle cysts	86
Dermoid cysts	16
Serous papillary cystadenocarcinomas	14
Corpus luteum cysts	11
Pseudomucinous papillary cystadenomas	6
Endometriosis of the ovary	4
Serous papillary cystadenomas	3

In a collected series of 160,324 admissions to gynecologic clinics, an incidence of ovarian tumors of 2.8 per cent was found.¹³ Table 1 represents a typical distribution in a reported series of 1101 ovarian tumors of various types.¹ Approximately 15 per cent of these tumors were malignant, of which 50 per cent were bilateral. Considering ovarian tumors of all types, it was found that they are most commonly observed in women between 30 and 40 years of age.¹ In a survey of 2083 cases of ovarian cancer reported, however, the average age was estimated to be between 49 and 52 years.⁹ Cases of malignant disease of the ovary have been reported in children and in patients over 80. In our series the youngest was 5 years old and the oldest 77 years.

It is not the purpose in this report to review in detail the various classifications of ovarian tumors which have been presented or to go into detail on the histology of the various types of ovarian tumors.

TABLE 2

CLASSIFICATION OF OVARIAN TUMORS ACCORDING TO NOVAK¹⁰*Benign Tumors*

- 1 Cystic
 - a Non neoplastic
 - Follicle cysts
 - Lutein cysts
 - Corpus luteum cysts (including corpus albicans cysts)
 - Theca lutein cysts
 - Germinal inclusion cysts
 - Endometrial cysts
 - b Neoplastic
 - Cystadenoma
 - Pseudomucinous
 - simple
 - papillary
 - Serous
 - simple
 - papillary
 - Dermoid
- 2 Solid
 - a Papilloma fibroma adenoma fibroma fibromyoma angioma lymphangioma, chondroma osteoma
 - b Brenner tumors
 - c Adrenal tumors (masculinovoblastoma)

Malignant Tumors

- 1 Carcinoma
 - a Primary solid carcinoma
 - Adenocarcinoma
 - Nonpapillary
 - Papillary
 - Medullary carcinoma
 - Carcinoma simplex
 - Scirrhous carcinoma
 - Alveolar carcinoma
 - Flexiform carcinoma
 - Mesonephroma (not clearly established as yet)
 - Fimbriate or dysontogenetic
 - Graafian cell carcinoma (often cystic)
 - Arrhenoblastoma
 - Dysgerminoma (seminoma)
 - Chorionepithelioma
 - b Cystic carcinoma
 - Pseudomucinous cystadenocarcinoma
 - Serous papillary cystadenocarcinoma
 - Epidermoid carcinoma arising in dermoid cyst
- 2 Secondary or Metastatic Carcinoma
 - a Adenocarcinoma simple
 - b Krukenberg tumor
 - c Epidermoid carcinoma
 - d Chorionepithelioma
 - e Hypernephroma
- 3 Teratoma (including struma ovarii)
- 4 Sarcoma (round-cell spindle-cell mixed cell)
- 5 Melanoma

Ewing has stated that ovarian tumors present a wider scope of structure greater individual variation and a more complex embryologic and histogenic basis than those of any other organ. For these reasons they have escaped satisfactory classification. In a substantial proportion of ovarian tumors as they actually occur the diagnosis is largely a matter of arbitrary decision on the part of the observer. In spite of the many different classifications of ovarian tumors that have been presented however it is important to classify such tumors in some manner for purposes of discussion. The classification of Novak¹⁰ using the benign or malignant nature of the tumor as the most important criterion has seemed the most practical to us. This classification of ovarian tumors is presented in Table 2.

CYSTIC BENIGN TUMORS OF THE OVARY

The non neoplastic tumors which comprise the common cystic tumors of the ovary are not related to the subject of malignancy except in the differential diagnosis and will not be reviewed. The neoplastic group the cystadenomas and the dermoids however have a understanding treatment

Cystadenomas may be classified as either serous or pseudomucinous. The pseudomucinous cystadenomas may attain enormous size and in general are larger than the serous variety. Characteristically they contain a thick pseudomucinous fluid. They usually consist of large rounded cystic compartments of varying thicknesses. The large majority of tumors of this type are of the mucinous type and are actually cent

the standpoint of malignant degeneration. Meyer⁸ believes that approximately 5 per cent of these pseudomucinous cysts may become malignant. Of particular importance in this type of tumor is the pseudomyxoma peritonei resulting from rupture of tumors of this type. Rupture of these tumors is followed by the implantation of pseudomucinous epithelium throughout the peritoneal cavity. They may penetrate the liver and other organs and set up various sources of secreting cells. Although these tumors are not truly malignant and are slow to develop this complication invariably results in an eventually fatal outcome.

Serous cystadenomas occur slightly less frequently than the pseudomucinous may attain a large size but in general are smaller than the pseudomucinous variety. They characteristically contain a straw colored fluid except when discolored by hemorrhage. The cysts are usually multilocular but may be made up of only a few large compartments. A much higher percentage of cystadenomas of this type may show papillary excrescences on the exterior of the cyst wall and,

even more common, in the interior of the tumor. Of particular importance in the consideration of malignancy are those tumors showing a papillomatous growth and Curtis³ emphasized that every tumor of the ovary with a papillomatous growth upon the outer surface must be regarded as a malignant tumor, irrespective of its histologic characteristics.

Curtis further stated that a benign papillary growth confined within a heavy capsule is relatively harmless, when the tumor has but a thin capsule, when there has been leakage of the cyst contents from tapping or following rupture or, most importantly, when there are papillomatous growths on the surface, the prognosis is more serious. When papillary growths are found on the surface of these tumors, peritoneal implants occur in at least 25 per cent of the cases. Even though these implants may regress following removal of the primary lesion, ultimate death is the usual eventuality. Furthermore, the histologic differentiation between the papillary cystadenoma and cystadenocarcinoma frequently is very difficult and at times impossible.

It may thus be seen from this discussion of the cystadenomas that a large percentage of these tumors making up the papillomatous variety must be considered as definite premalignant tumors. Thus an early diagnosis of the cystadenomas and their treatment constitute a very important aspect of our attack on ovarian cancer.

The differential diagnosis of minute cystomas from simple retention cysts is primarily an academic one and of no particular significance. When tumors attain any appreciable size however, the detection of a papillomatous growth is very important. These latter tumors are usually of greater weight than the simple cysts. There is more of a tendency to fixation and they have a nodular firm surface.

Nodules in the cul de sac are suggestive of a papillary growth. Although ascites may be found with the simple cyst variety usually the presence of ascites indicates a more serious prognosis.

It is unfortunately common that many of the cystadenomas do not cause early symptoms, however disturbances of menstruation are frequent although sterility is rare. Pain in the pelvis and sensations of weight and pressure may occur.

On physical examination cystic ovarian tumors usually are found anterior to the uterus, which is an important differential point in diagnosing inflammatory cysts. The latter are usually lateral and posterior to the fundus. It must be remembered that the boggy, painless swelling of a tubal pregnancy may also be commonly found anterior

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cystadenomatous group of benign ovarian tumors. Final diagnosis

must await the intra-abdominal examination of the tumor by the surgeon and usually a histologic examination of the tumor by a pathologist

All patients with an ovarian cystic tumor 7 cm or more in diameter should be carefully observed. A thin-walled, soft cyst will usually prove not to be a cystadenoma and may vary in size on repeated examinations or actually disappear. The persistence of the tumor, its firmness, induration, nodules, heaviness, pain, increase in size and demonstrable ascites are indications for exploration and probable removal.

In discussing the treatment of the cystadenomas, the prevention of any spilling of the tumor content is to be particularly emphasized because of the danger of implants. The tapping of cysts is to be avoided whenever possible.

Dermoid cysts occur frequently, comprising, according to Curtis,⁴ approximately 10 per cent of all ovarian tumors. They are the most common tumor found in children, sarcoma being the next most frequent. They may attain considerable size, develop slowly and are usually not found until adult life. The usual contents of dermoids found elsewhere, hair and teeth and other epithelial structures, are common. Torsion of the pedicle occurs frequently, associated ascites is rare. The importance of bowel perforation as a result of the extension or perforation of the dermoid ovarian cyst has been mentioned in the literature. These tumors may develop malignancy, although malignant degeneration probably does not occur in over 1 or 2 per cent of tumors of this type.¹⁴ Dermoid tumors frequently are bilateral and when such tumors are found, careful inspection of the opposite ovary must be made as the tumor in the adjacent ovary may be very small and frequently not detected unless a careful search is made. In such instances bilateral oophorectomy is indicated.

DIAGNOSIS OF CANCER OF THE OVARY

The age incidence in the group of 64 cases of carcinoma of the ovary reported in this series is presented in Table 3.

In this group of patients, 15 or 24 per cent had never married. Twenty-nine patients, or 45 per cent, had borne an average of three children. Twenty, or 31 per cent, were married but had never been pregnant. Unfortunately, and it has been generally recognized, there is no early characteristic symptomatology of carcinoma of the ovary. In our series of cases, 26 patients, or 40 per cent, came to the clinic for examination because of an abdominal enlargement and a feeling of a lump in the lower abdomen. This is the usual first sign of an ovarian tumor. This enlargement may be associated with a feeling of heaviness and pressure in the pelvis and occasionally with pain. Two patients particularly mentioned associated pain. Fifteen patients, or 23 per cent, came primarily because of pain or distress in the lower ab-

domen without recognized abdominal enlargement. Eleven presented varying gynecologic complaints. Of the latter group, the most common were menorrhagia and metrorrhagia. Ten or 15 per cent were detected on routine pelvic examination (Table 4). Amenorrhea may occur.⁶ In the literature, hyperplasia of the mammary gland, even accompanied by lactation, virilization and various other endocrine changes have been described.¹² It is recognized that fertility is

TABLE 3
AGE INCIDENCE

Age Group	Number	Per Cent
5-30	4	6.2
31-40	7	10.9
41-50	21	32.6
51-60	18	28.1
Over 60	14	21.8
Total	64	

Average 50.0 years

definitely decreased in the presence of ovarian carcinoma, and one of our patients came to the clinic primarily because of sterility.

The symptoms caused by metastasis of ovarian tumors are common and deserve no special emphasis. Ascites is frequent. Hydrothorax is frequently noted. Anemia, fever and emaciation are usually found only in the late stages of the disease.

In establishing the diagnosis of carcinoma of the ovary, it is to be remembered that malignant tumors are usually lateral to or behind

TABLE 4
CHIEF COMPLAINT

	Number	Per Cent
Abdominal pain	15	23
Abdominal enlargement	26	40
Pain and enlargement	2	3
Incidentally discovered on routine pelvic examination	10	15
Various gynecologic complaints (menorrhagia, metrorrhagia, sterility)	11	17
Total	64	

the uterus, whereas simple cysts and tubal pregnancies are found anterior to the uterus.¹³

any solid ovarian tumor. Induration, fixatic suggest malignancy. Induration and nodules in the cul de sac are common. Of particular significance is bleeding after the menopause in patients in whom curettage has ruled out the presence of malignant disease in the uterus. Frequently, these tumors are small but careful

and repeated examinations of the ovary must be made with the possibility of a neoplasm in the ovary considered. The presence of ascites hydrothorax and other signs suggestive of ovarian metastases must be borne in mind.

In the differential diagnosis particularly in bilateral tumors the possibility of metastatic Krukenberg's tumors from the gastrointestinal tract must be remembered. The differentiation from diverticulitis and carcinoma of the sigmoid for masses in the left pelvis must be ruled out. Peritoneoscopy may be of assistance in establishing the diagnosis.

In many of these cases however particularly in the benign but definitely premalignant papillary cystadenomas the diagnosis will be made only at operation. A careful and complete abdominal exploration must of course first be made the presence of ascites the presence of peritoneal omental or other implants or metastases noted both ovaries must be inspected and it must be remembered that 50 per cent of malignant tumors occur in both ovaries. Before the ovary is removed all abdominal contents should be carefully walled off to avoid the danger from spilling of cystic content. All ovarian tumors following removal should be sectioned in the operating room by an assistant and the contents of the tumor noted. When there is any question of malignancy histologic examination by means of a frozen section by a competent pathologist should be made immediately. It is only in this way in many of these patients that a diagnosis will be made and radical surgery carried out when indicated.

TREATMENT

The treatment of the benign papillary cystadenoma is excision. Even during the child bearing period when the tumors are bilateral careful consideration must be given to the bilateral removal of these definitely premalignant tumors.

When malignancy can be established radical surgery must be carried out as in any other type of malignant disease. The operation should consist of a radical resection of the tumor when necessary, isolation of the ureter, removal of both the fundus and cervix and because of the high incidence of bilateral ovarian cancer removal of both ovaries is included. Pemberton¹¹ has emphasized the importance of routine resection of the omentum in these patients because of the high incidence of omental metastases. This custom has not been followed in our series but certainly merits careful consideration when the procedure does not add an undue risk to the patient.

The types of operation carried out in our series are tabulated in Table 5. It is to be noted that in several of these cases the radical type of operation which we now believe essential was not carried out. In the majority of instances this was because histologic examination of the tumor was not made at the time of operation and the presence of a definite ovarian malignancy was not demonstrated.

The majority of observers advise the use of deep radiation therapy in addition to surgery in the treatment of these cases

TABLE 5
TYPES OF OPERATIONS IN GROUP I

	No Recurrence (5 Years)	Dead or Recur- rence at Last Examination
Unilateral oophorectomy	1	4
Bilateral oophorectomy	0	8
Supravaginal hysterectomy and bilateral oophorec- tomy	7	8*
Complete hysterectomy and bilateral oophorec- tomy	1	2†
Exploratory laparotomy	0	5

* Six of these were done in the presence of demonstrable peritoneal implants

† Done in the presence of demonstrable peritoneal implants

It has been our policy following operation for cancer of the ovary to give patients deep radiation therapy 2000 r is given through each of two portals anteriorly and two portals posteriorly. The entire pelvis is covered. Forty one of our patients received radiation therapy

TABLE 6
RESULTS
Group I
(Operated on prior to March 1942)

	No Recurrence (5 Years)	Known Dead or Recurrence	No Recent Follow up	Total
Number	9	27	9	45
Per cent	14	42	14	

Group II
(Operated on After March 1942)

	No Recurrence after				Known Dead or Recurrence	No Recent Follow up	Total
	1 Yr	2 Yrs	3 Yrs	4 Yrs			
Number	6			2	7	4	19
Per cent	9			3	10	6	

Various end result studies have been reported in the literature, recording five year survival rates varying from 14 to 32 per cent.^{7, 11} The end results in our series are reported in Table 6. Of 45 patients operated on prior to 1942, 9 have survived without evidence of recurrence for five or more years. This is an incidence of 14 per cent.

SUMMARY AND CONCLUSIONS

1 Characteristically, ovarian cancer does not cause early symptoms. An abdominal enlargement, lower abdominal pain and disturbances of menstruation are the common symptoms noted.

2 The importance of the premalignant, benign neoplastic ovarian tumors, that is the papillary cystadenomas, must be appreciated and the tumors removed when found. Unfortunately, the papillary cystadenomas also do not present characteristic early symptoms.

3 Because of the absence of early symptoms in carcinoma of the ovary and the potentially malignant ovarian tumors, the importance of routine pelvic examinations in women during the child bearing and postmenopausal ages cannot be too strongly emphasized. All solid ovarian tumors should be regarded as potentially malignant.

4 The establishment of a diagnosis of ovarian malignancy or potential ovarian malignancy will depend on the detection of ovarian cancer and the papillary cystadenoma at the time of operation in the majority of cases. When a solid ovarian tumor is encountered at operation, careful inspection and palpation of both ovaries and adjacent structures must be made. Following the removal of such a tumor, it should be sectioned immediately and histologic examination made at once if there is any suspicion of cancer.

5 When the diagnosis of cancer of the ovary is established at operation, as radical an approach to this form of malignancy must be made as to cancer in any other region of the body. Both tubes and ovaries, uterus and cervix and, when indicated, adjacent structures such as the omentum must be removed.

6 In the removal of ovarian tumors the importance of the avoidance of spilling of the contents, and the careful search for implants and metastases in the abdominal cavity must be appreciated.

7 Intensive deep radiation therapy should be given to these patients postoperatively.

8 With the establishment of an early diagnosis of carcinoma of the ovary, with radical removal of these tumors and with the use of deep radiation therapy, the end results should be reasonably good and the five year survival rate approach that of carcinoma of the breast and carcinoma of the colon and rectum.

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SARCOMA OF THE UTERUS

NEIL W SWINTON AND GEORGE O MILES

SARCOMA is an infrequent malignant disease of the uterus. Because of the association of sarcoma of the uterus with myomas and the importance of adequate surgical treatment when sarcoma is encountered the characteristics of this type of malignant disease must be appreciated by all who are interested in pelvic surgery.

Between 1928 and 1946 at the clinic 75 patients with sarcoma of the uterus have been operated on. At the present time it has been possible to review the records of the 43 of these patients operated on prior to April 1, 1942.

INCIDENCE

In Table 1 the age incidence and marital status of these patients is shown. The youngest was 31 years of age and the oldest 63. The

TABLE 1
AGE INCIDENCE MARITAL STATUS

Age Years	Unmarried Childless	Married Childless	Married Children	Total in Age Group
0-30	0	0	0	0
31-40	7	4	5	16
41-50	7	0	12	19
51-60	2	0	4	6
61-70	0	0	2	2
Total	16	4	23	43

average age was 45.5 years. Forty-four per cent of the patients were in the fifth decade. Eighty-one per cent were under 50, 36 per cent were unmarried, and 45 per cent were childless.

Novak has reported 59 cases of uterine sarcoma in a series of 26,973 gynecologic specimens. In this series the relative frequency of uterine sarcoma and the more common uterine lesions are shown in Table 2. Sarcomas constituted 4.5 per cent of the uterine malignancies exclusive of the chorionepithelioma. Kimbrough has reported an incidence of sarcoma of 3.2 per cent.

Wheelock and Warren have reported a series of 148 myosarcomas of the uterus. These were graded into three groups on the basis of cellular differentiation. One hundred and thirteen were designated

clinically benign and placed in grade I. Thirty five were grouped as grade II and grade III. During this period when 35 sarcomas of the uterus were found there were 2600 leiomyomas, an incidence of 1.35 per cent. In leiomyoma, most writers accept an incidence of 1 to 2 per cent of leiomyosarcoma.

In this same series there were 1520 carcinomas of the uterus. Again comparing this with the grade II and grade III sarcomas, the incidence of sarcoma to carcinoma of the uterus was 1 to 43. The usually accepted figure ranges from 1 to 40 to 1 to 50.

There may be some misunderstanding in the use of the term leiomyosarcoma, clinically benign. Wheelock and Warren admit that these tumors are grossly leiomyomas, yet histologically they show an increased number of abnormal mitoses, increased cellularity, tumor giant cells, and other altered microscopic features. Because of these deviations from normal cytology they do not believe it is possible to classify this group as benign histologically and the term is used to describe both the histologic and clinical course.

TABLE 3

RELATIVE INCIDENCE OF UTERINE SARCOMA AS COMPARED WITH MORE COMMON UTERINE LESIONS OBSERVED IN 26,973 CASE SPECIMENS (FROM NOVAK)

Diagnosis	Number of Patients	Incidence Per cent
Myoma uteri	6,981	25.9
Adenocarcinoma of fundus	241	0.89
Adenocarcinoma of cervix	68	0.33
Epidermoid carcinoma of cervix	134	0.5
Sarcoma of uterus	59	0.22

Leiomyosarcoma is most commonly found arising in a fibromyoma. In Wheelock and Warren's 35 cases graded II and III, 32 arose from a preexisting myoma. Endometrial sarcoma is an infrequent form of uterine sarcoma and a rare type is sarcoma botryoides.

Sarcoma of the uterus may be found in any portion of the organ, but more frequently in the fundus than in the cervix. In 3 cases found that the fundus of the uterus was involved and in only 68 cases found that the cervix was involved.

DIAGNOSIS

Unfortunately, as in carcinoma of the ovary, there is no characteristic symptomatology of sarcoma of the uterus. The chief complaints in our series are shown in Table 3. It must be remembered that sarcoma of the uterus arises most frequently in a preexisting myoma; therefore, an altered menstruation, abdominal tumor, and the usual symptoms of a fibroid uterus will be the most common complaints found on a statistical study of such a group. Certain symptoms, however, may suggest sarcomatous changes.

An abnormal vaginal discharge, although infrequent in our series, is commonly reported to suggest sarcoma. A thin, watery discharge may be present. This may become serosanguineous and in the later stages of the disease, because of involvement of the endometrium, may become foul. The rapid growth of supposedly benign leiomyomas, particularly after the menopause, always suggests the possibility of sarcoma. Pain is frequently associated with tumors of this type early in the disease, and it has been reported that pain is more likely to be an early symptom of sarcoma than of carcinoma of the uterus.

Again, however, as in carcinoma of the ovary, the majority of cases of sarcoma of the uterus will be diagnosed only at the time of operation. A few may be detected by curettement, but the majority by the gross and histologic examination of the tumor.

Because of the frequency of leiomyomas of the uterus there is a tendency to be careless at operation in the examination and interpretation of uterine fibroids. The possibility of leiomyosarcoma should always be considered. Wheelock and Warren, in their study, mention

TABLE 3
CHIEF COMPLAINTS IN 43 PATIENTS

	Number	Per cent
Altered menstruation	21	49
Pelvic pain	9	21
Enlarging abdomen	9	21
Incidental finding	8	19
Vaginal discharge	2	5
Urinary frequency	8	19

the following gross characteristics that should cause one to suspect the presence of sarcoma in a fibroid uterus:

- 1 Unusual friability of the broad ligament
- 2 Unusual vascularity of the tumor
- 3 The absence of a sharp line of demarcation between the tumor and the myometrium
- 4 The difficulty in shelling out the tumor from its apparent circumscribed limit.
- 5 The opaque appearance of sarcoma instead of the usual silky, glistening appearance of the leiomyomas
- 6 An edematous and partially spiculated appearance of the cut surface which is softer than that of the ordinary fibromyoma.

In general, sarcomas are soft to moderately firm, may be necrotic, may be poorly encapsulated, and on section may bulge above the cut surface.

Novak stated that sarcomas usually occur near the center of myomas, but may occur near the periphery. Endometriosarcomas may resemble polypoid structures, and those arising from the cervix are frequently

clinically benign and placed in grade I. Thirty five were grouped as grade II and grade III. During this period when 35 sarcomas of the uterus were found there were 2600 leiomyomas an incidence of 1.35 per cent. In leiomyoma most writers accept an incidence of 1 to 2 per cent of leiomyosarcoma.

In this same series there were 1520 carcinomas of the uterus. Again comparing this with the grade II and grade III sarcomas the incidence of sarcoma to carcinoma of the uterus was 1 to 43. The usually accepted figure ranges from 1 to 40 to 1 to 50.

There may be some misunderstanding in the use of the term leiomyosarcoma clinically benign. Wheelock and Warren admit that these tumors are grossly leiomyomas yet histologically they show an increased number of abnormal mitoses, increased cellularity, tumor giant cells and other altered microscopic features. Because of these deviations from normal cytology they do not believe it is possible to classify this group as benign histologically and the term is used to describe both the histologic and clinical course.

TABLE 2

RELATIVE INCIDENCE OF UTERINE SARCOMA AS COMPARED WITH MORE COMMON UTERINE LESIONS OBSERVED IN 28,973 CASE SPECIMENS (FROM NOVAK)

Diagnosis	Number of Patients	Incidence Per cent
Myoma uteri	6981	25.9
Adenocarcinoma of fundus	211	0.89
Adenocarcinoma of cervix	88	0.33
Epidermoid carcinoma of cervix	034	0.5
Sarcoma of uterus	59	0.22

Leiomyosarcoma is most commonly found arising in a fibromyoma. In Wheelock and Warren's 35 cases graded II and III, 32 arose from a preexisting myoma. Endometrial sarcoma is an infrequent form of uterine sarcoma and a rare type is sarcoma botryoides.

Sarcoma of the uterus may be found in any portion of the organ, but is found more frequently in the fundus of the uterus than in the cervix. In a series of 59 cases found that the fundus of the uterus was involved in 68 per cent and the cervix in only 68 per cent.

DIAGNOSIS

Unfortunately, as in carcinoma of the ovary there is no characteristic symptomatology of sarcoma of the uterus. The chief complaints in our series are shown in Table 3. It must be remembered that sarcoma of the uterus arises most frequently in a preexisting myoma; therefore, an altered menstruation, abdominal tumor and the usual symptoms of a fibroid uterus will be the most common complaints found on a statistical study of such a group. Certain symptoms, however, may suggest sarcomatous changes.

3 The treatment of sarcomas of the uterus is surgical. The uterus, cervix, tubes and ovaries and other structures as indicated should be removed.

4 The end results in the treatment of sarcoma of the uterus are favorable particularly in those arising in myomas.

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mistaken for benign cervical polyps. These polyps, however, are usually larger and more friable than the usual cervical polyps. There may be associated ulceration and infection suggestive of carcinoma.

Novak also called attention to the rare grape like sarcoma of the cervix (sarcoma botryoid) so commonly found in children. This sar-

the time of operation if the possibility of sarcomatous degeneration of leiomyomas is considered. All uterine tumors should immediately be sectioned in the operating room. If any variation from normal is observed, a frozen section should immediately be obtained.

TREATMENT

When the diagnosis of sarcoma of the uterus is made, the uterus including the cervix, tubes, ovaries and adjacent structures, as indicated, should be removed. It is true, as has been noted by many observers, that in the presence of sarcomas which are grossly confined to the body of the uterus, subtotal hysterectomy has been satisfactory in a relatively high percentage of cases. Total hysterectomy, however, is the operation of choice.

In the literature, there is considerable dispute as to the value of radiation therapy. At the clinic radiation therapy has not been used in the treatment of sarcoma of the uterus.

In Novak's series of 57 cases, end results were available in 50. Of these, 15 patients, or 30 per cent, were without evidence of recurrence at the end of five years. This had dropped to 12, or 24 per cent, at the end of ten years. Novak emphasized the point that the outlook for patients with sarcomas of the uterus arising in myomas is relatively good. The mural and endometrial variety are much less favorable.

12, 12 were
teen years
cases

SUMMARY AND CONCLUSIONS

1. Sarcoma of the uterus is an infrequent malignant tumor comprising 3 to 4 per cent of uterine cancer. It occurs in a ratio of 1 to 40 or 1 to 50 to carcinoma and is found in 1 to 2 per cent of leiomyomas of the uterus.

2. The diagnosis of sarcoma of the uterus will seldom be made before operation. At any pelvic operation when myomas are encountered the possibility of sarcoma must be considered. The gross characteristics of sarcoma have been enumerated. All myomas should be immediately sectioned at the time of operation and histologic study of the tumor made on any suspicion of sarcoma.

The diagnosis must be held in rigid circumspection in all instances of postmenopausal bleeding or in the presence of menstrual irregularity characterized by abnormal flow. The confirmation is obtained by utilization of the vaginal smear technic and diagnostic curettage. Either or both tests may be negative in the presence of malignant disease and astute clinical judgment may be required when symptoms persist after negative microscopic analyses have been recorded.

The pathologic specimens showed adenocarcinoma in 28 instances and adenoacanthoma in 5 others. In one specimen the carcinoma was suggestive of an origin in an area of endometriosis within the myometrium.

METHOD OF MANAGEMENT

The literature reflects a broad area of agreement with respect to the primary role that surgery plays in the therapy of carcinoma of the uterine corpus. There is, on the other hand, considerable confusion regarding the appropriate place of roentgen and radium therapy in the management of this condition. Most radiologists and surgeons concede that irradiation should be employed as the sole therapeutic agent only in those cases in which the lesion is clearly inoperable or in instances in which radical operation is contraindicated. In recent years the trend has favored the use of preoperative irradiation followed by hysterectomy after an interval of six weeks. Scheffey et al. prefer intracavitary radium for this purpose, while Miller believes that radiation therapy is superior in this regard.

It has long been the judgment at this clinic that preoperative irradiation would not alter significantly the salvage rate in carcinoma of the fundus since this preliminary treatment could not affect the scope of the subsequent resection, except perhaps in cases of borderline operability. It has seemed to us that one must rely on the radicalness of the surgical procedure for cure and that any beneficial results from irradiation had best be reserved for the postoperative period. Consequently, the method of management here at the clinic has been as follows:

Every patient complaining of postmenopausal bleeding and every patient with irregular menstruation characterized by abnormal flow which does not respond to medical treatment is referred to the gynecologist. After a diagnostic curettage is performed and the results are reported, preparation is made and the patient is admitted to the hospital.

After the manner of Wertheim is performed. The detailed features of this technic were described recently by Dr. Lahey.

The cervical canal is occluded with purse string sutures of chromic catgut as a preliminary step to the abdominal hysterectomy. The ovaries and fallopian tubes are removed routinely even though they are apparently normal.

The fundus is removed by the abdominal route. The infundibular ligaments are ligated and the lateral pelvic vessels are ligated.

CARCINOMA OF THE CORPUS UTERI

KENNETH W. WARREN

THE discovery and progressive refinement of newer diagnostic procedures in the detection of uterine cancer, combined with an increasing awareness on the part of the feminine public regarding the wisdom of periodic physical examinations magnify the responsibility of the physician in the management of this disease. Early recognition of carcinoma originating in the endometrium followed by radical hysterectomy (Wertheim) and the judicious use of irradiation offers a reasonable assurance of cure in the majority of cases.

The vaginal smear technic for the detection of uterine carcinoma was first described by Papanicolaou in 1928 and later elaborately illustrated in the monograph by Papanicolaou and Traut. The efficacy of this test has been confirmed by several authors. Meigs and his associates found this procedure to be reliable in approximately 93 per cent of cases of untreated carcinomas of the cervix and 85 per cent of cases of adenocarcinoma of the corpus uteri. McClure and Cattell screened 170 cases at the Labey Clinic by utilizing the cervical smear technic. Of these, 146 tests gave negative results, 5 were positive and 19 were equivocal. Two of the positive reports were proved to be in error when a malignant tumor was not found in either of the surgically removed uteri. Each contained multiple fibroids. The scope of the material tested in this instance is too limited to warrant significant conclusions, but we believe that the vaginal smear technic merits further study as a diagnostic procedure for the detection of
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features of this disease

The group included 2 individuals under 40 years of age, and 5 under 50 years of age. Twenty-four patients were between 50 and 70 years of age, while 2 were more than 70 years of age.

The presenting symptom was postmenopausal vaginal bleeding in 82 per cent of the cases. Six patients complained of irregular menstruation, and subsequent diagnostic curettage confirmed the suspicion of malignant disease. Twenty-four of the group were married and 18 had borne children.

The pelvic findings discerned by bimanual manipulation were remarkable only in their inconclusiveness. Although the uterus was enlarged in many instances, reliable signs of malignant disease were present only in the far advanced cases.

The diagnosis must be held in rigid circumspection in all instances of postmenopausal bleeding or in the presence of menstrual irregularity characterized by abnormal flow. The confirmation is obtained by utilization of the vaginal smear technique and diagnostic curettage. Either or both tests may be negative in the presence of malignant disease and astute clinical judgment may be required when symptoms persist after negative microscopic analyses have been recorded.

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Every patient complaining of postmenopausal bleeding and every patient with irregular menstruation characterized by abnormal flow which does not respond quickly to conservative measures is subjected to a diagnostic curettage. An immediate analysis of a frozen section preparation is made and if carcinoma is found, total hysterectomy after the manner of Wertheim is performed. The detailed features of this technique were described recently by Dr. Lahey.

The cervical canal is occluded with purse string sutures of chromic catgut as a preliminary step to the abdominal hysterectomy. The ovaries and fallopian tubes are removed routinely even though they are apparently free from malignant involvement in many instances.

The infundibulopelvic ligaments are divided and ligated near the lateral pelvic wall. The round ligaments are severed and the peritoneal

leaflets on the anterior and posterior aspect of the broad ligament are incised thereby exposing the uterine vessels and the ureter. The course of the ureter is then delineated from the pelvic brim to its entrance into the bladder. The uterine vessels are traced to their origin and are clamped, divided and ligated well lateral to the carefully exposed ureter. The parametrial tissue is then wiped toward the lateral aspect of the cervix and vagina which have been exposed by reflecting the bladder well down along the anterior vaginal wall. The uterosacral ligaments are divided and the uterus is removed by severing the superior vaginal cuff some distance from its attachment to the cervix. The vaginal vault is suspended by utilizing the round ligaments. The pelvic peritoneum is then closed with meticulous care avoiding the ureters which are adherent to the pelvic peritoneum.

In recent years it has been customary in this clinic to administer irradiation following total hysterectomy for carcinoma of the corpus except in those instances in which histologic analysis reveals the malignancy to be *in situ*.

RESULTS

We are now conducting a survey of the entire group in order to determine the cumulative salvage rate from this method of management and these data will be reported in a subsequent communication.

Preliminary analysis reveals that of 33 patients treated at the clinic during the period selected for study 26 had radical hysterectomy as described and 1 in whom the diagnosis of malignant disease was made only by histologic examination of the removed uterus had a supravaginal hysterectomy. Palliative resection was done in 2 instances. No operation was performed in 4 cases.

There was 1 postoperative death, the result of a cerebrovascular accident on the fifth day following operation, a mortality of 3.5 per cent. There have been in addition 3 deaths subsequent to treatment in patients who exhibited no signs of recurrence at their demise. One died from a perforated ulcer three years following hysterectomy, 1 succumbed to chronic nephritis eight months after operation and another died of senility two years after treatment at the age of eighty three years.

Twenty-one patients have been traced for five years or until obvious recurrence or death from unrelated cause had taken place. If the 3 patients who died within five years of treatment and who showed no recurrence before death are eliminated there are 18 cases upon which to base an estimate of five year survival. Of this number 6 patients had demonstrable recurrence, 2 after an elapse of one year and 1 each after an interval of two, three, four and five years. Twelve patients were well and free of obvious recurrence from five to ten years following operation. Thus the five year salvage rate is approximately 67 per cent.

CONCLUSIONS

Early diagnosis of carcinoma of the endometrium should become increasingly frequent with the refinement of newer diagnostic methods and with increasing knowledge on the part of the feminine public regarding the significance of the symptoms of the disease

Radical hysterectomy with removal of the adnexae offers a reasonable prospect of cure in a majority of cases

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TOTAL CYSTECTOMY FOR CARCINOMA OF THE BLADDER

EARL E EWERT

THE complete removal of the urinary bladder for carcinoma has been accomplished by many urologists enough times to foresee some attempts at standardization both as to the extent of the lesion with the degree of its malignancy and of the technical steps. The problem would then seem to resolve itself into two great divisions: first the wise and thoughtful selection of an extensive but operable lesion and second the best form of urinary diversion for that particular patient.

SELECTION OF PATIENTS

The decision to subject a patient to this extensive procedure must be based on many factors. It demands intense individualization of every patient suffering with early invasive carcinomas or those with large seemingly superficial growths of the bladder. It can be said that total cystectomy should be reserved only for those patients in whom some measure of success can reasonably be expected. Here tofore it has been thought of as a last measure for those with large infiltrating tumors readily palpated by rectum or for those in whom the walls of the bladder are so infiltrated that the bladder itself can be palpated suprapubically as if distended with urine. These patients are no more amenable to complete removal of the bladder and urinary diversion than are patients suffering with inoperable carcinoma of the stomach or bowel.

At the present time removal of the bladder is reserved for (1) early invasive lesions of the floor or large sessile growths that are so extensive that destruction by either desiccation or radium is impossible or cannot be adequately carried out; (2) invasive lesions involving the posterior bladder wall encroaching on either one or both of the ureteral orifices or when a large more superficial cancer has been present long enough to invite suspicion that it is quite deep; and (3) lesions involving the bladder neck of such size that again adequate destruction by desiccation or radium will fail in its accomplishment.

The indications for total cystectomy may be more simply stated by saying that they must so be assayed in each operator's mind that after he has decided to embark upon a program of urinary diversion and complete removal of the bladder he must have arrived at the conclusion that the lesion cannot be handled safely by more conservative means and that the lesion is operable. This is no field for enthusiasts one way or the other.

The following plan for selecting patients for total cystectomy has

been followed (1) A careful history must be taken as to the duration of the symptoms and any previous treatment and report of the tumor if previously removed (2) Cystoscopy is carried out under anesthesia in the hospital where a biopsy specimen is obtained and careful inspection of the bladder permits the determination of whether or not extensive infiltration has occurred by filling and emptying the bladder. A combination of rectal and bimanual palpation is done at the same time (3) Excretion urograms are routinely made to determine whether any obstruction of the ureter exists or whether papillomatosis of the kidney and ureter exists and the bladder is only the last seeded ground from up above. If necessary, retrograde pyelograms are made to prove this point (4) The urine should be cultured to determine the kind of organism present since most of these patients have an infected urine, so that chemotherapy and the correct antibiotics are used.

Placing one's confidence entirely upon the result of the biopsy report as to the degree of malignancy will lead to disaster in many cases. It is not always possible to obtain representative specimens from every part of the tumor. It often does not give the pathologist a fair chance to grade the carcinoma. Also, despite the fact that the tumor may be of a low grade of malignancy or even a "benign" papilloma, the clinical progress of such a neoplasm will not agree with the microscopic analysis. That this is true is substantiated by the following case report.

A man 50 years old was first seen because of hematuria of nine and a half months duration and was admitted to the hospital with a diagnosis of multiple papillomas of the bladder. Biopsy specimens were taken from scattered lesions. The diagnosis returned from the pathologic laboratory was benign papillomas. Pyelographic studies of the upper urinary tract were normal. Deep x-ray therapy was given following his initial fulguration but he was admitted to the hospital for three successive coagulations during the next year and a half. Examination of biopsy specimens each time disclosed simple papillomas of the bladder. Two years after his initial fulguration the bladder again was so full of tumors that a cystectomy was done with transplantation of the ureters into the skin. Retrograde pyelography done by way of the ureterostomy stoma subsequently on two occasions revealed no evidence of any papilloma of the upper urinary tract.

Six years later the patient returned because of bleeding from the left kidney. Retrograde pyelograms at this time disclosed a typical filling defect consistent with an intrapelvic growth of the left kidney. Left nephrectomy and ureterectomy were then done which revealed a large sessile growth of the left kidney pelvis without involvement of the ureter. Multiple sections from the friable fungating growth which filled the pelvic lumen were examined and a diagnosis was made of papilloma with precancerous change.

While the patient was in the hospital at this time he complained of occasional bleeding from the penis. The entire urethra which now consisted of only the penile portion and the bulbous urethra was endoscoped and papillomas were discovered along its entire length. A perineal urethrostomy was done in order to allow the current of water to flow through to facilitate endoscopy, and the entire

urethra was thought to be destroyed by thorough fulguration. Bleeding persisted and attempts to fulgurate the scarred and distorted canal were not possible.

The penis and what remained of the urethra were removed. The diagnosis after microscopic examination of what remained of the urethra was finally revealed as epidermoid carcinoma grade II.

In a period of eight years this man had (1) four transurethral fulgurations of the bladder (2) total cystectomy with bilateral ureterostomy to the skin (3) left nephro-ureterectomy (4) three fulgurations of the urethra and (5) removal of the penis and the remainder of the urethra for so called benign papillomas.

METHOD OF URINARY DIVERSION

The problem of total cystectomy is essentially the problem of urinary diversion. Here one is confronted with the difficulty of handling a fluid in such a way as to permit a reasonable degree of personal comfort on the part of the patient. Urinary diversion can be accomplished by (1) diverting the urinary stream via the ureter to the skin on the abdomen (2) bilateral nephrostomy catheters in the lumbar region and (3) directing the urine into the bowel by means of a ureterosigmoidostomy.

Cutaneous ureterostomy may be demanded by virtue of the fact that the patient is aged and debilitated and this is a palliative procedure for him or her or that multiple procedures are not wise for this patient. Marked ureteral dilatation on one or both sides with urinary tract infection may also restrict the operator's choice to this method. Cutaneous ureterostomy on either one side or the other is a safe procedure carried out quickly and disturbs the patient little or none at all. At the present time in those patients in whom cutaneous ureterostomy is decided upon as the safest procedure for this individual patient intensive chemotherapy or antibiotic therapy is carried out as a routine procedure. A modified Gibson incision is made in either groin so that the ureter stoma is placed well enough away from the anterior superior spine to permit easy application of the ureterostomy cup. The ureter at the same time is placed low enough so that the vascular supply of the proximal ureter is disturbed as little as possible and the ureter is brought out through an aperture in the muscular wall and not involved in the line of incision. No sutures are applied to the ureter itself and a small whistle tip soft rubber catheter is used if possible to prevent overdistention of the ureteral wall and the resulting ischemia. This is done so that a small bud of ureter

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with cement

cement and the cup has been so effective that in many instances a belt is not required to hold the cup in place and the patient is kept perfectly dry. At the present time the ordinary ureterostomy cup

with the inflatable rim is used without distention. One of the patients has recently devised a cup which is merely a wide flange cemented to the skin. Little or no irritation has resulted and the cup is changed every four to five days and recemented in place. This method of handling a cutaneous ureterostomy has proved so effective that all forms of inlying catheters have been given up. The use of an inlying catheter in the ureter is at best a necessary evil and patients who have handled themselves in this way have experienced many distressing episodes of wetness. This avoids also the periodic bouts of fever and development of kidney stones in many.

Some have been kept on small, more or less permanent doses of sulfonamides, with perfect comfort and absence of any fever during their daily active life.

Nephrostomy for diversion of the urinary stream in normal kidneys other than those with small degrees of hydronephrosis is difficult to handle when reinsertion of the tube becomes necessary, and the patient is more or less under constant supervision by his or her urologist. Although this method promised greater control in keeping the patient dry, a certain amount of kidney trauma and chronic polynephritis could not be avoided.

At the present time *ureterosigmoidostomy* is done by us through the same approach that is applied in a cutaneous ureterostomy procedure through the groin. It has been found in our hands that the extraperitoneal approach is the safest. The intestine is not disturbed since it is felt that any material in the bowel is less contaminating than liquid feces. Many of the patients are prepared without changing the diet, and a cleansing enema is given the morning or the afternoon before and none the night or the morning of the operation. In this way there is no leakage of the bowel content at the time the ureter is inserted into the sigmoid. Sulfathalidine is given two or three days previously, although no difference has been noted in the postoperative course of patients who are not given this drug by mouth. The right side is diverted into the bowel first. The external oblique is opened in the line of its fibers and then the internal and external oblique are split in the direction of their muscular fibers so as to open into the extraperitoneal space. These muscles are then cut superiorly and inferiorly so as to permit adequate exposure. The ureter is quickly identified crossing the iliac vessels, and is divided close to the bladder. It, however, is mobilized only for a short distance toward the kidney, carefully preserving the vessels. It has been noted that if this is done without disturbing the ureter from its bed, the cut end of the ureter will ooze and the viability thereby is insured.

The opening in the peritoneum is made inferiorly as close to the base of the sigmoid mesentery as possible (Fig. 251). This is necessary because frequently the sigmoid is adherent on the left side. The sigmoid is quickly identified by the longitudinal striations and fatty

epiploica and is drawn through the aperture of the peritoneum. It is so placed that no knuckling of the bowel occurs to produce even partial constriction of the lumen. The peritoneum is fastened by means

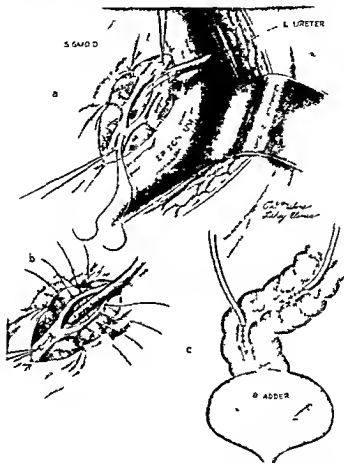


Fig. 251—*a* The peritoneum adequately tacked about the sigmoid prevents intra abdominal contamination. Exposure is quite adequate.

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transplantation of the ureter can easily be carried out without the use of pads and soiling of the peritoneal cavity is eliminated. Two silk stay sutures are placed through the serosa and muscularis of the sigmoid at either end before making the bed or trough for the ureter. This trough need not be more than 2 to 3 cm. in length. The incision in the longitudinal Colles band penetrates through to the mucosa and the muscularis is undermined quite thoroughly so that no compression of the ureter results when this trough is closed over it. Particular attention is paid here and if this is done the urine in many instances will be draining into the rectal tube at the finish of the operation. The ureter itself is prepared by cutting it at an angle or "fish mouthing" it and a double ended needle brought through the ureter so that a good purchase is obtained by the stitch. It is also well to observe here that there is no twisting of the ureter on its axis and the ureter lies in the same position going into the bowel as it does coming from the bed. The mucosa is grasped with a mosquito forceps at the lower angle of the bed and the mucosa opened. The forceps control the stoma into the bowel and each needle in turn is passed into the bowel well down inferiorly and is brought out on the serosal side of the bowel itself. This adequately secures the ureter into the sigmoid. This stitch is tied loosely on the outside. Here again tying the suture tightly will produce a necrotizing suture and possibly a fistula of the bowel. The same type of catgut suture number 5-0 is used to close the trough over the ureter and usually three sutures suffice. With a judicious selection of the site in the sigmoid and with tacking the peritoneum about the bowel there will be no tension whatsoever on the ureter and its blood supply will be preserved without sloughing. No sutures are put through the ureter. A small Penrose tube is placed at the depth of the wound and the closure accomplished. The advantages of the extraperitoneal approach are several: the peritoneal cavity is not soiled, the peritoneum anchors the sigmoid and the postoperative convalescence is smooth. Any error in technic at this point will result only in a ureteral fistula. This has happened to us on two occasions.

On the left side transplantation must be carried out at a higher level. It may be necessary to open the peritoneum almost in the midline to determine the lateral level of the sigmoid so that this aperture in the peritoneum can be placed as close to the peritoneal reflection as possible to eliminate any tension or changing the course of the sigmoid. This is particularly true in obese patients in whom the mesentery is distended with fat.

A rectal tube is kept in place after each procedure for a period of five to seven days although it is our impression that five days is sufficient at the time the patient is allowed out of bed. The Penrose tube is left in place for nine or ten days to insure adequate retroperitoneal drainage. Although both stages have been done at one time

epiploica and is drawn through the aperture of the peritoneum. It is so placed that no knuckling of the bowel occurs to produce even partial constriction of the lumen. The peritoneum is fastened by means

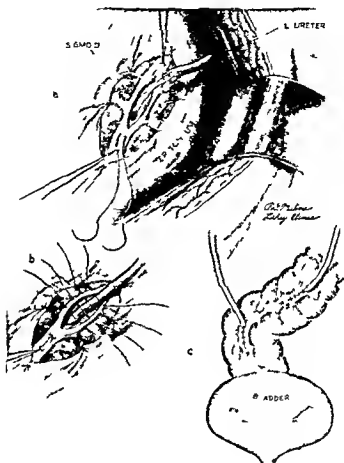


Fig. 251—*a* The peritoneum adequately tacked about the sigmoid prevents

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of atraumatic sutures to the sigmoid at each corner of the peritoneum and usually four tacking sutures suffice. A wise selection of this aperture in the peritoneum prevents any form of tension and the

The layers of Denonvilliers' fascia are not disturbed. The membranous urethra is severed and the prostate mobilized anteriorly, breaking through the prostatic pubic attachment anteriorly, and the bladder freed laterally by blunt dissection with the finger. Posteriorly, the vesicles are mobilized and the vascular stalks of each seminal vesicle are secured. It is frequently necessary to insert a small pack anteriorly between the bladder and the symphysis pubis to stop any ooze. By this inferior approach the bladder is almost half mobilized (Fig



Fig. 253—The bladder has now been mobilized through the space of Retzius superiorly, and is also freed bilaterally at the same time. The vascular stalks of the seminal vesicles can now be clamped and cut. The suprapubic approach can take in most of the peritoneal coat over the bladder.

253) This wound is closed and a Penrose tube drain is placed in the lower portion, and then the patient placed in position for a suprapubic approach. A midline incision is made in an undisturbed field so that any previous wound induration from intra-abdominal approach for transplantation of the ureters is avoided. If necessary, because of the location of the tumor on the low posterior wall, the peritoneum is taken with the bladder. The superior and inferior vesical blood supply is quickly secured and the only serious bleeding is about the

in favorable cases, a week is allowed between each transplantation. The bladder is removed at the end of the second or third week.

Postoperatively, after diversion of the urinary stream into the sigmoid, adequate fluid is administered and a determination of the nitrogen level is made between operative steps. A rise in the nitrogen level has been observed at times after each step, and this is believed to be the result of absorption of urine by the bowel.

TECHNIC OF TOTAL CYSTECTOMY

The removal of the bladder in males is accomplished in the following manner (Fig. 252). The patient is placed in the same position as for a radical removal of the prostate for carcinoma. The steps are

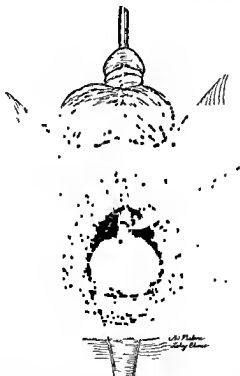


Fig. 252—Classical perineal approach is made and the layers of Denonvilliers' fascia are not disturbed. The seminal vesicles are removed with the bladder quite easily by this approach, and dissection posteriorly facilitates the dissection from above.

the same, namely the use of a curved perineal incision and exposure of the prostate by division of the rectourethralis muscle, and the gland brought into position by the use of the long prostatic tractor.

MALIGNANT DISEASE IN THE UNDESCENDED TESTIS

OSCAR B. MURRAY AND EARL E. EWERT

THE presence in the hospital at the same time of two physicians with malignant disease of the undescended testis has prompted us to review our cases of tumors of the undescended testis and to examine our statistics in regard to the number of cases of undescended testicles in the last five years.

There is some understandable variation throughout the literature^{1 2 4} in the reported incidence of testicular malignancy. The general statistical data show an incidence of 0.5 to 0.6 per cent in relation to malignant disease of all other organs. The Memorial Hospital in New York, however, quoted an incidence of 2.09 per cent with regard to all other malignant tumors in males.

In reviewing the literature it is definitely established that the incidence of malignant disease of the testes is markedly accelerated in those that are undescended. In one series of 694 cases of undescended testes, 11 per cent were malignant. Cancer of the testes associated with ectopy in over 11 per cent of the recorded cases indicates a correlation 48 times greater than expected by chance association.

In patients with cancer of one testis and unilateral cryptorchidism, 97.5 per cent of the tumors are in the ectopic testis. In bilateral cryptorchidism with unilateral testicular cancer, a tumor of the second testis developed in 24 per cent, whereas when both testes were in the scrotum a second testicular tumor developed in but 0.7 per cent of the cases. The frequency of bilateral involvement of the ectopic testis is 32 times that of the scrotal testis.

In view of these facts we believe that the ectopic testes must be regarded as a potentially malignant tumor. It would seem from the literature of unilateral cryptorchidism that if the testis cannot be replaced in the scrotum it should be removed.

At the Litchey Clinic during the last five years there have been 50 cases of ectopic testicles. During this same period 14 patients were seen with testicular tumor and of these 14 the tumor was in the undescended testis in 4 cases, an incidence of over 28 per cent.

Although the scrotal testis is readily accessible to examination, an average period of fifteen months elapsed from the time the patient first noticed the swelling until he presented himself for treatment. Perhaps because of the painless enlargement of the testicle as the most common presenting symptom, this long delay is explainable. These patients are most often seen between the ages of 20 and 50, which is during the years of greatest sexual activity.

The diagnosis of malignant disease must be based on an ever

ureteral stalk, which can be adequately controlled. There is almost complete absence of shock following the removal of the bladder. This removal can be accomplished by means of the inferior and superior approach in a little more than an hour in not overly obese patients. Any troublesome ooze can be easily controlled by means of foam sponges and packing. Transfusion is routinely given at this stage. Patients are out of bed on the fourth or fifth day and the absence of postoperative disturbance has been noteworthy.

In some of the patients leakage of the urine per rectum has been noted after the perineal approach in males but division of the rectourethralis muscle close to the mouth tends to avoid or minimize this. There has been no case of leakage of urine by the rectum at the time the patients are ready to leave the hospital.

SUMMARY

1 Total cystectomy has been done on 17 patients for carcinoma of the bladder. In the aged bilateral, simple, cutaneous ureterostomy is perhaps the safest procedure, using the new cutaneous ureterostomy cup with cement.

2 Extraperitoneal approach for ureterosigmoidostomy would seem the next safest form of urinary diversion, eliminating the chances of intra abdominal contamination from infection and leaking of urine.

3 Total cystectomy for carcinoma of the bladder should be re

large infiltrating lesions fixed to the rectum or pelvis

The right testis could be palpated in the inguinal canal just distal to the external ring. There was no enlargement of the inguinal nodes and no masses palpable in the abdomen. The consistency and the size of the testis seemed to be within normal limits.

A right orchiectomy was carried out at this time and the testis was found to be in the mid inguinal canal. It was grossly normal in appearance and size.

The pathologic report revealed atrophy of the testicular elements with a small focus of embryonal carcinoma. Serial sections showed no extension beyond the original focus (Figs 254 and 255).

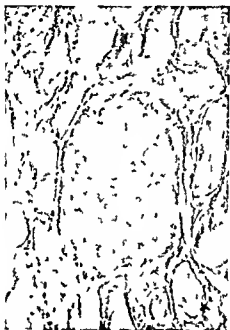


Fig. 255 (Case 1) —High power magnification of the same field shown in Figure 254

We believe this case is one of the earliest malignancies of the testes seen. An Aschheim Zondek test was not done in this case as malignancy was not suspected.

CASE 2—A physician aged 48 entered the clinic for examination because of a symptomless mass in the left pelvis. There was a history of bilateral cryptorchidism with removal of the right testis at an earlier date.

Physical examination was negative except for the palpable mass. Laparotomy was carried out with removal of the mass. Frozen sections at this time revealed carcinoma. The microscopic examination showed embryonal carcinoma with lymphoid stroma and a few atrophic testicular tubules. Grossly, this mass was found to be about 15 cm in diameter lying free in the pelvis except for an attachment to the left spermatic cord and an attachment to the lower portion of the ileum by an adhesion.

present suspicion whenever any type of swelling, usually painless, occurs in this scrotum. The Aschheim Zondek test is helpful only when positive and does not exclude the presence of malignant disease when negative. It has also been demonstrated that there is no close correlation between the amount of hormone in the urine and the structure of the testicular tumor. One exception perhaps, is the chorionepithelioma. This condition produces a gonadotropic hormone often in great amounts. The amount of hormone in the urine after removal of the tumor and x ray treatment can be used at times as a criterion both as to the efficacy of the therapy and to determine the need for further therapy while the patient is under close observation.

We wish to report the 4 patients with tumors of the undescended testis.

REPORT OF CASES

CASE 1—A 35 year old physician stated that he had had a right inguinal hernia repaired when he was five years of age at which time the right testis was transfixed to the inguinal canal. It had remained just distal to the external ring.



Fig. 254 (Case 1)—The only focus of embryonal carcinoma found is shown (low power)

since the time of operation. He was quite definite of the fact that the testicle was in the scrotum prior to operation. He stated that for the past few months there had been some pain and tenderness in the ectopic testis. This was particularly prominent when he stood or when pressure was applied to the testis.

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CASE 3—A man, aged 32, was seen at the clinic because of abdominal pain and a palpable mass in the abdomen.

On examination, the left testis was found to be in the scrotum, the right was not palpable in the canal or the scrotum. Through a laparotomy incision, a mass was removed and a pathologic diagnosis was made of embryonal carcinoma. Postoperatively, this man was given intensive x ray therapy, but his urine continued to give a strongly positive Friedman test. The patient died within a year.

CASE 4—A 24 year old man entered the clinic complaining of low back pain. Abdominal examination revealed a mass extending from the pelvis to the navel. There was also a mass measuring 8 cm. in diameter, in the right supraclavicular fossa. The right testis was not in the scrotum, the left testis appeared to be normal on palpation. His condition was such that only a biopsy specimen was obtained from the mass in the supraclavicular fossa. The pathologist made a diagnosis of metastatic carcinoma, teratomatous in origin. The patient died shortly after operation.

SUMMARY

The literature is reviewed with regard to the incidence of testicular tumor in ectopic testes in relation to the incidence in testes that are normally present in the scrotum. It is shown that the incidence of malignant disease in the normally situated testes is slightly over 0.5 per cent, while that of the ectopic testes is over 11 per cent. The difference in these statistics is striking and cannot be overlooked. The frequency of bilateral changes in the ectopic testes with relation to involvement of the scrotal testes was also reviewed. The incidence of involvement of the second ectopic testis was 24.6 per cent, whereas in the scrotal testes after involvement of the first there was an incidence of only 0.7 per cent in the second. Orchidopexy does not preclude the possibility of the development of malignant disease according to Gilbert. A review is presented of 4 cases of malignant disease of the ectopic testes, one of which showed a very early focus of embryonal carcinoma.

CONCLUSIONS

1. The undescended testis is particularly liable to undergo malignant degeneration possibly from repeated small, unnoticed traumatic disturbances, either by muscle or direct violence or because the important heat regulating mechanism of the scrotum has been lost.

2. We believe that the optimum time for orchidopexy is just before or during adolescence since few testes descend after this time.

3. If it is impossible to replace a unilateral cryptorchid testis in a normal position, it should be removed and no palliative procedure, such as placing it in the abdomen, should be carried out.

4. A patient with an intra abdominal cryptorchid testis presenting himself for examination should be made aware of the very potential malignancy he carries.

5. The Aschheim Zondek and Friedman tests are helpful only when positive and nothing takes the place of a highly suspicious attitude toward a painless swelling of the scrotum in an adult male.

hygiene, a long foreskin and sometimes a persistent urethral discharge appeared to be factors favoring their development. Excision, cauterization with various agents and the use of 25 per cent podophyllin in oil all gave good results, and if combined with circumcision, permanent cure was obtained.

The diagnosis of *lentic chancre* likewise need not be discussed in detail.

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ordinary nonspecific *balanitis* and *balanoposthitis* posed no special problem and since they were almost always associated with phimosis or at least a redundant prepuce, these conditions responded well to circumcision and appropriate local measures. *Herpes progenitalis* was recognized by its vesicular appearance at onset, later becoming crusted or very superficially ulcerated. Since the lesions ordinarily disappeared in a week or ten days, simple cleanliness and careful drying constituted the only treatment found necessary.

Leukoplakia was noted to have the same characteristics on the penis as elsewhere. A whitish, patchy thickening due to epidermoid proliferation and keratinization, without ulceration or induration, it is not malignant but should be considered potentially so. The policy followed in dealing with this condition was biopsy, circumcision, light fulguration and periodic observations.

The *erythroplasia* of *Queyrat*, *Paget's disease* and *Bowen's disease of the penis* may resemble each other very closely so that clinical differentiation is usually impossible. *Queyrat's erythroplasia* is characteristically a reddened velvety patch, sometimes ulcerated with no induration but often surrounded by a zone of scaly dermatitis. The same description may fit both *Paget's* and *Bowen's diseases* except that the ulcer of *Paget's disease* has very sharp red margins, and in *Bowen's disease* the borders are rolled. The latter condition is often associated with skin tumors elsewhere in the body. Positive diagnosis of these lesions can be made only by careful microscopic study of a biopsy specimen, and since all may be early carcinoma, there should be no delay.

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extent of involvement of the penis, (2) presence or absence of metastases, (3) associated infection, (4) age of the patient, and (5) co-existing disease which might influence operability. In general, a carcinoma less than 2 cm in size and showing only superficial involvement is thought suitable for destruction by irradiation alone, thus preserving a useful penis, larger lesions are amputated surgically. For carcinoma involving less than the distal half of the penis, we feel that simple amputation 2 cm proximal to the involved area is the procedure of choice, complete amputation with perineal urethrostomy

SOME PENILE LESIONS AND CARCINOMA OF THE PENIS

VERNON S. DICK

CARCINOMA of the penis in this country comprises but a small percentage of malignancies of the genito urinary tract but is nevertheless important because its treatment is still not as effective as it should be. This is due in large part to failure to apply adequate therapy early in the course of the disease a condition most often resulting from the patient's delay in consulting a physician but sometimes owing to the practitioner's inability to recognize or suspect an early carcinoma. In recent years however perhaps because of wider education of the public and the physician in the field of cancer increasing numbers of patients with relatively minor penile lesions have been observed at the Lahey Clinic and a few cases of early carcinoma discovered. The majority of these patients were found to have simple benign or inflammatory lesions easily diagnosed, but a few required considerable observation and biopsy to prove or disprove malignancy. A brief discussion of some of the lesions commonly seen with a statement of our present policy in the treatment of carcinoma of the penis is the purpose of this paper.

Practically all the lesions (all those considered precancerous or early cancer) occurred in uncircumcised individuals. This is in line with what is known regarding the prophylactic value of circumcision during infancy. Phimosis retention of smegma and chronic balanoposthitis were frequently noted being very probably of etiologic importance. The possibility that these conditions produce an environment favorable to the action of some carcinogenic agent has long been realized for cancer of the penis is exceedingly rare in persons adequately circumcised early in life and in whom these predisposing conditions cannot occur.

The frequently seen lesions of the penis which presented little difficulty in diagnosis were the venereal wart (benign papilloma or condyloma acuminatum) the luetic chancre herpes progenitalis and ordinary nonspecific balanitis and balanoposthitis. Leukoplakia and the erythroplasia of Queyrat were observed more rarely and though no proven cases of Paget's disease of the penis or Bowen's disease of the glans penis were found these conditions were considered in the differential study in a few instances and should be mentioned here. Darkfield examinations were made use of for all lesions in which there

hygiene, a long foreskin and sometimes a persistent urethral discharge appeared to be factors favoring their development. Excision, cauterization with various agents and the use of 25 per cent podophyllin in oil all gave good results, and if combined with circumcision, permanent cure was obtained.

The diagnosis of *luetic chancre* likewise need not be discussed in detail, for if the possibility of syphilis is borne in mind while seeing all penile lesions, properly performed darkfield examinations and serologic studies will usually confirm the clinical judgment. Similarly, the ordinary *nonspecific balanitis* and *balanoposthitis* posed no special problem and since they were almost always associated with phimosis or at least a redundant prepuce, these conditions responded well to circumcision and appropriate local measures. *Herpes progenitalis* was recognized by its vesicular appearance at onset, later becoming crusted or very superficially ulcerated. Since the lesions ordinarily disappeared in a week or ten days, simple cleanliness and careful drying constituted the only treatment found necessary.

Leukoplakia was noted to have the same characteristics on the penis as elsewhere. A whitish, patchy thickening due to epidermoid proliferation and keratinization, without ulceration or induration, it is not malignant but should be considered potentially so. The policy followed in dealing with this condition was biopsy, circumcision, light fulguration and periodic observations.

The *erythroplasia of Queyrat*, *Paget's disease* and *Bowen's disease of the penis* may resemble each other very closely so that clinical differentiation is usually impossible. Queyrat's erythroplasia is characteristically a reddened velvety patch, sometimes ulcerated, with no induration but often surrounded by a zone of scaly dermatitis. The same description may fit both Paget's and Bowen's diseases except that the ulcer of Paget's disease has very sharp red margins, and in Bowen's disease the borders are rolled. The latter condition is often associated with skin tumors elsewhere in the body. Positive diagnosis of these lesions can be made only by careful microscopic study of a biopsy specimen, and since all may be early carcinoma there should be no delay in performing this procedure and initiating treatment.

When the extent of the lesion is small, the following factors must be considered: (1) extent of the lesion, (2) associated infection, (3) age of the patient, and (4) co-existing disease which might influence operability. In general a carcinoma less than 2 cm in size and showing only superficial involvement is thought suitable for destruction by irradiation alone, thus preserving a useful penis, larger lesions are amputated surgically. For carcinoma involving less than the distal half of the penis, we feel that simple amputation 2 cm proximal to the involved area is the procedure of choice, complete amputation with perineal urethrostomy

is reserved for the few cases showing more extensive penile invasion.

Bilateral dissection of inguinal lymph nodes is indicated in all cases we believe except those in which there are extensive metastases or in which other diseases would make the surgery very hazardous. Even when irradiation alone has been used on the penis, dissection of the regional nodes seems logical since metastases have been known to occur early from very small primary lesions. It is recognized that metastases can develop in the deep inguinal or iliac nodes directly and cannot be satisfactorily attacked surgically but unless such spread is definitely known to be present, it seems advisable to remove as many of the regional lymph nodes as possible. This is consistent with the treatment of carcinoma elsewhere in the body. With present day preoperative and postoperative care, gentle operative technique and the use of chemotherapy and antibiotics, the risks of the additional surgical procedure should not be great and an occasional additional cure may be obtained. Although efforts in the past at more extensive removal of the deep lymph nodes draining the penis were not too successful, perhaps further trial under present conditions may be justified.

Early recognition of carcinoma of the penis and prompt adequately radical treatment are the essentials for cure.

THE TREATMENT OF PRIMARY MALIGNANT BONE TUMORS OF THE HUMERUS

G E HAGGART

THE first step in the management of suspected malignant tumors of the humerus as has been emphasized elsewhere in this volume is to obtain an accurate history perform a careful physical examination and secure adequate roentgenographic studies. The next and very important step is a biopsy taking care to avoid damaging the surrounding soft parts in so far as possible. If the preoperative clinical and roentgenologic examinations strongly indicate malignancy then definitive treatment can be planned if a frozen section study confirms the diagnosis. If the preoperative findings are not clear cut however then only a biopsy is done. The final evaluation is determined after the permanent sections are studied.

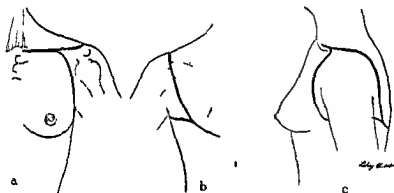


Fig. 256—Diagram of incisions—see text

With the diagnosis of a malignant bone tumor of the humerus established and in the absence of demonstrable metastases or in selected cases as a palliative procedure the patient is advised to have an interscapulothoracic amputation.

The operation of interscapulothoracic amputation has been condemned by some writers but our experience with 5 cases does not accord with that opinion. Not only has the operation prolonged life in patients without demonstrable metastases but also the procedure has prevented continued extreme suffering when employed simply as palliative treatment as is so well illustrated by Case 2. If operation is decided upon it is most important that the patient have a clear conception of the reason for such surgery and likewise definitely understand the very appreciable deformity that will result.

THE OPERATION

As reported in the literature when discussing interscapulothoracic amputation, the majority of writers have employed the "racket" incision and early ligation of the subclavian vessels, described by Berger. In our hands this approach has not proved satisfactory since the

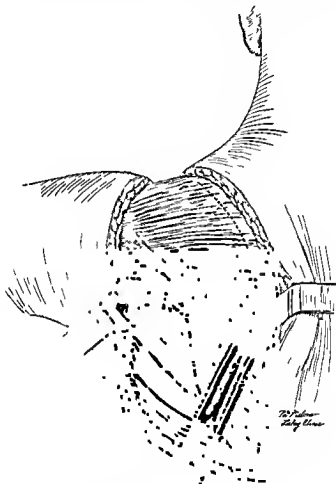


Fig. 257—Illustrating the posterior exposure and division of the trapezius muscle

of performing this operation is after the technique of H. Littlewood,

published in 1922. With some modifications, this procedure has been followed in operating on our patients, with satisfactory results.

The patient lies on his uninvolved side. The first or posterior (cervicoscapular) incision begins at the medial end of the clavicle

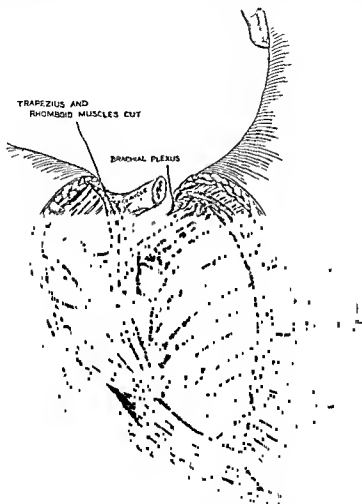


Fig. 255—Completion of posterior muscle division. Clavicle has been cut (see text) and arm allowed to fall forward, thus clearly delineating the brachial plexus and subclavian vessels.

just lateral to the insertion of the sternomastoid muscle, and extends laterally to the point of the shoulder, then sweeping downward along the axillary margin of the scapula to the angle of this bone whence it is prolonged toward the spine (Fig. 256, *a* and *b*). After sub-

periosteal dissection of the clavicle, the entire skin and subcutaneous tissue flap exposed by this incision are elevated toward the midline, revealing the posterior surface of the scapula. The inferior margin of



Fig. 259—With exception of latissimus dorsi, all the anterior muscles have been divided. At operation the cut ends of the plexus and subclavian vessels are actually completely covered by the proximal flap.

12. The pectoralis muscle is then identified and by blunt dissection is

scapulae and rhomboid muscles are cut. With retractors the vertebral margin of the scapula is then drawn upward and the fibers of the serratus magnus muscle divided close to the chest wall.

Following division of the inner end of the clavicle the subclavius muscle is incised and then the extremity allowed to fall forward thus exerting tension on the subclavian vessels and the brachial plexus which are easily identified and widely exposed (Fig 258). Because the operator is not working down in a deep hole and there is minimal bleeding, this relatively simple method of identifying and treating the subclavian vessels and the brachial plexus is the keynote of the success of this procedure. The artery is first clamped and ligated then the vein and thereafter the three large trunks of the brachial plexus are divided by the cautery. It is not necessary to inject the nerve trunks of the plexus with procaine. If desired resection of a portion of the cervicodorsal sympathetic trunk can also be performed at this stage.

The surgeon now moves to the other side of the table facing the patient and the anterior incision is made beginning at the middle of the clavicle curving downward just lateral to and parallel with the deltopectoral group crossing the upper axillary fold and joining the posterior incision (Fig 256 c). To minimize bleeding in a muscular individual it is particularly advantageous to dissect directly over the relatively delicate deep fascia covering the deltoid trapezius and latissimus dorsi muscles. The pectoral muscles are divided about 2 inches (5 cm) distal to their origin on the chest wall for cosmetic reasons the latissimus dorsi similarly treated and thereafter the extremity and shoulder girdle removed (Fig 259).

The skin subcutaneous tissue and deep fascia are then closed in the usual manner with Penrose tube drains in the dependent portion of the wound and a snug compression dressing applied. In this connection an appreciable amount of blood can be saved the patient when the bone tumor is located in the upper third of the humerus by preoperatively wrapping the extremity beginning at the finger tips in an Esmarch bandage and then applying a tourniquet in the mid arm area.

RESULTS

Five patients have been operated on by the technic described. There has been no operative mortality. As illustrative of the two types of patients treated a detailed case report of a patient without demonstrable metastases and a report on one patient in great physical distress with metastases to axillary nodes are presented together with brief notes on the remaining cases.

REPORT OF CASES

CASE I—A welder age 41 was admitted to the bone and joint department of the Lahey Clinic February 8 1943 with the complaint of progressive pain

and disability in the left shoulder which he attributed to a lifting strain that occurred in January 1942 (Fig 260). He had been given various types of conservative treatment elsewhere, but disability continued to become progressively more marked.

Routine physical examination was entirely negative, as also were the blood studies, urine examinations and a roentgenogram of his lungs. The orthopedic examination was not remarkable save in relation to the left shoulder which exhibited pronounced generalized muscle atrophy and marked loss of motion. The maximal range of lateral abduction was 35 to 40 degrees. He stated it felt as though there was a block inside the joint which prevented him from moving it, and there was moderate degree of pain.

The roentgenograms on admission (Fig 261) revealed partial destruction of the head of the humerus and neck, with cystic changes and widening of the individual trabeculations. It was then felt that the diagnosis lay between some



Fig 260—Case 1 Roentgenogram taken elsewhere eleven months before admission

type of chondroma, cases sicca form of tuberculosis, or possibly an atypical Paget's osteitis. In view of the progressing disability and pain the patient was advised that a definite decision should be made and a biopsy carried out to which he agreed.

On February 12, 1943, the left shoulder joint was opened through an anterior incision of the hockey-stick type (Fig 262), preserving the deltoid musculature, carrying the dissection down between the deltoid and pectoral muscles. This permitted wide visualization of the joint capsule which, externally, seemed negative except over its inferior aspect where there appeared to be some fluctuation. The capsule was here incised parallel to the fibers of the internal rotator muscles, revealing a markedly hyperplastic synovial membrane of a gray-yellow color and a moderate increase in the amount of joint fluid. The head of the humerus presented numerous fissures and semidetached masses of cartilage were heaped up especially on the inner aspect of the head, acting as a block to abduction which process extended well into the bone of the head of the humerus. The



Fig 261—Case 1 Admission roentgenogram



Fig 262—Case 1 Photograph illustrating a traumatic incision employed for exploration and biopsy of shoulder joint

glenoid fossa was negative and that portion of the proximal humeral shaft visualized was also negative. After removing specimens for microscopic examination, the wound was closed in layers and the wound healed.

After intensive study of the sections, Dr Shields Warren in consultation with Dr F B Wolbach, reported that the process was a low grade osteogenic sarcoma which would not respond to radiation therapy

After explaining the situation in detail to the patient and making clear what operation entailed interscapulothoracic amputation was advised and accepted Operation was performed March 10, 1943 From this procedure the patient convalesced uneventually Figure 263, *a* and *b* are photographs of the patient a week after operation

During the ensuing two and a half years this man reported frequently for check up examinations which were consistently negative He was back at work, running a special electrical truck which he manipulated well and his income equaled that which he had received before his operation June 25, 1945, he came in for one of his usual check up examinations and at that time there was the first evidence in the roentgenograms of the chest of questionable areas of metastases Clinically the patient had no complaints and continued actively at work

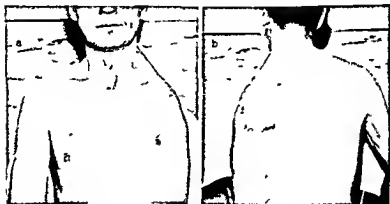


Fig 263—*a* and *b* Case 1 Photograph one week after operation

The patient was readmitted to the hospital December 24 and discharged December 31, 1945 with a history that in the past two weeks he had begun to

autopsy was not obtained.

CASE 2—A single woman aged 68, was admitted to the clinic on April 5

and the pain was so severe she would not consent to any type of treatment that would give relief

A roentgenogram (Fig 265) revealed an extensive osteolytic lesion of the upper end of the humerus as well as clearly illustrating the dense shadows of tumor involvement in the axilla so easily palpable on clinical examination, and especially along the anterior axillary margin and extending out over the posterior surface of the scapula. Metastatic malignancy seemed the most probable diagnosis. Every effort was made to establish the site of a primary lesion as well as to determine the presence or absence of other metastases. All of these studies, including roentgenograms of the skeleton, lungs, genito urinary and gastrointestinal tracts, pelvic examination and blood studies were entirely negative. It was, therefore, felt that this might well be a primary osteolytic sarcoma, and the patient was advised to have an interscapulothoracic amputation, not with the



Fig 264—Case 2. Preoperative photograph. Note marked swelling and edema of left arm. See text.

idea of a definite cure but rather to relieve her of the very marked discomfort then experienced and which would unquestionably become much more pronounced in the near future. On this basis she accepted operation.

Interscapulothoracic amputation was performed on April 29, 1940, by the technic described. The patient withstood the procedure extremely well and her convalescence following operation was uneventful.

Frozen section at operation indicated a highly malignant tumor, the exact character of which it was difficult to determine. Later studies by Dr. Shields Warren were reported as "rapidly growing malignant tumor, probably an atypical fibrosarcoma."

Following operation, the patient's course was followed at frequent intervals and then radiation therapy was started because there appeared to be recurrence

of tumor in the lateral chest wall. The roentgenogram of the lung, October 22, 1940, revealed no evidence of metastases. The patient then stated she felt fine. Six weeks after this date, however, she reported shortness of breath and clinically gave evidence of respiratory embarrassment, and was therefore readmitted to the hospital where she died December 2, 1940.

An autopsy was performed and after extensive study of the sections obtained, Dr. Shields Warren reported that in his opinion the final diagnosis on this patient was Ewing's tumor of the left humerus with pulmonary metastases, the actual cause of death being a thrombosis of the right pulmonary artery and right renal vein. There was also evidence of a metastatic sarcoma to the skin of the left chest, left pleura, peritoneum and right periaortic nodes.



Fig. 265—Case 2. Admission roentgenogram. Arrows outline soft tissue tumor mass.

CASE 3—A housewife, aged 31 years, was admitted July 29, 1943, because of painful swelling and disability in relation to the upper right humerus and shoulder joint area, of some two years' duration. A biopsy had been performed elsewhere April 19, 1942, and when we finally obtained these slides, the diagnosis by our pathologist was osteochondroma.

There was marked disability and loss of shoulder joint motion. The roentgenograms revealed an oval, soft tissue mass, 9 by 14 cm., lying largely lateral to the upper end of the humerus, with many irregular areas of calcification. The underlying cortex of the humerus was irregular on its external surface but appeared intact throughout. The medullary cavity of the bone was not involved. Roentgenograms of the lungs were negative. It was believed that probably the tumor was malignant and an interscapulothoracic amputation was advised, providing frozen section confirmed this diagnosis. The patient refused and was, therefore, discharged.

Because of continued symptoms, the patient returned to the hospital December 11, 1943. It was then decided that in view of the biopsy done elsewhere and further roentgenologic studies, perhaps this was a benign lesion, an osteochondroma, and removal was carried out on December 20, 1943. The pathologic report revealed low grade chondrosarcoma. She still refused any further surgery and was therefore again discharged January 3, 1944, with the wound healed.

The patient returned May 15, 1944, at which time it was obvious that the tumor mass had recurred and markedly increased in size, hence confirming the diagnosis of malignancy. The patient then accepted interscapulothoracic amputation, which was performed on May 25, 1944, followed by an uneventful convalescence. She was discharged from the hospital June 7, 1944, the wound completely healed, and in excellent general condition. At no time had there been any evidence of metastases, either in the lungs or bones of the skull, ribs, pelvis, or long bones of the extremities.

On December 30, 1946, two years and seven months after operation, this patient was completely free of symptoms or evidence of metastases, and was carrying on her usual household duties.

CASE 4—A physician, aged 62 years, was admitted to the clinic May 28, 1943, with a persistent ulceration of the stump of the index finger of the left hand, of nine months' duration, with swelling of the arm and hand for three months. He reported that the index finger was injured on broken glass in September 1941. Infection thereafter followed and a finger amputation was done, following which he had no symptoms for a year, but in September 1942, he struck the stump of the finger against a table, and thereafter the infection again flared up, and had not healed since that time.

In summary, the clinical and roentgenologic examinations indicated evidence of bone invasion, with skin changes in the hand suggestive of epidermoid carcinoma. It was also felt that there was additional involvement in the nodes about the elbow and axilla. On June 9, 1943, tissue was removed from the fingers, as well as nodes from the elbow and axilla, which revealed an epidermoid carcinoma. An interscapulothoracic amputation was therefore advised.

Operation was performed on June 23, 1943, by Dr. Ralph Adams. The patient was discharged from the hospital July 4 of that same year with the wound healed and in excellent general condition. Microscopic studies revealed epidermoid carcinoma, grade II, together with involvement of the removed axillary lymph nodes.

On July 24, 1944, clinical and roentgenologic examination showed the patient to be in excellent general health, and no evidence of metastases. He continued in active practice until June 3, 1945, when he suddenly became ill and finally died at home July 29, 1945, from widespread metastases.

CASE 5—A young man, aged 18, was admitted to the clinic September 18, 1946, with a complaint of ache and pains in the right shoulder and complete loss of function of the shoulder joint, of two months' duration. The onset was relatively rapid, for no known cause. The clinical examination and roentgenograms indicated there was a malignant lesion of the head of the humerus, of the osteoblastic type. Two weeks before admission he had been seen by another physician and a biopsy performed. These slides on examination by our pathologist were reported as osteogenic sarcoma. A roentgenogram of the lungs was negative.

The patient was advised to have an interscapulothoracic amputation which was performed on September 30, 1946. He convalesced without complications.

At the present time six months later clinical examination is negative including a roentgenogram of the lungs. The patient is asymptomatic.

CONCLUSIONS

Proven primary malignant bone tumors of the humerus are best treated by interscapulothoracic amputation in patients without demonstrable metastases and in selected cases as a palliative procedure.

The preoperative diagnostic studies are briefly reviewed and the technic of the operation described.

Five cases are reported, two in detail. There were no operative deaths. The end results indicate this method of treatment is well worth while.

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THE PREOPERATIVE MANAGEMENT OF MALIGNANT BONE TUMORS

G E HAGGART AND FRANK L SHIFF

IN 1921 the Registry of Bone Sarcoma was established by the American College of Surgeons. Since that time our knowledge of malignant bone tumors has increased tremendously. Nevertheless, the management of these cases has failed to keep pace with the advances thus made. This failure has resulted primarily from errors or delays in diagnosis, either of which can preclude any hope of success. This latter, if it is to be achieved, requires early recognition and prompt treatment.

Bone tumors are believed to comprise approximately 1 per cent of all malignancies. Since the skeleton is of mesenchymal origin the growths are sarcomatous in type. The principal lesions encountered are osteogenic sarcoma, Ewing's tumor, multiple myeloma and metastatic carcinoma.

To the physician in general practice, who is called upon daily to treat individuals with symptoms referable to the musculoskeletal system, these patients can present major diagnostic problems, because the possibility of malignancy must always be kept in mind. All too many of these patients subsequently are referred or find their way to orthopedic surgeons after long periods either without treatment or, what is sometimes worse, after palliative treatment for "rheumatism," "arthritis" or similar complaints. If such tragedies are to be avoided

are inquisitive

Unexplained

y a malignant

bone tumor until proven otherwise. Every such patient demands a complete diagnostic survey. The following case reports illustrate some of the pitfalls which may be encountered.

REPORT OF CASES

CASE 1—An 11 year-old girl was referred to the clinic for consultation in June 1935. Her principal complaint was persistent intense pain in the right shoulder which had become apparent gradually since August 1934. The patient had noticed increasing cyanosis and sweating of the right hand three months before examination. Numbness of the hand on dependency had occurred for the first time two months later. The clinical diagnosis was Ewing's tumor of the humerus.

The child showed marked atrophy of the shoulder with loss of muscle power in the shoulder and elbow. Exquisite tenderness was elicited over the upper shaft of the humerus but no definite mass could be defined. Radiologically, a diffuse zone of cortical sclerosis 60 cm in length was visualized, involving the proximal humeral metaphysis. This surrounded an irregular area of medul

lary destruction. The lungs and the other bones showed no evidence of metastasis. Laboratory examination was negative. A tentative diagnosis of sclerosing osteomyelitis was made and exploration was advised. It should be noted that the child was employed as a photographer's model. Her parents objected strenuously to any suggestion that an operation was necessary, on the grounds that it

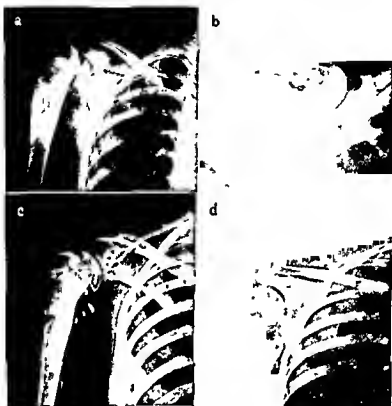


Fig. 266 (Case 1)—Necrosis of bone resulting from excessive irradiation
a, June 1935. Sclerosis of cortex with early periosteal reaction. Central area of rarefaction.

b, November 1941. Epiphysis now fused. Shaft and head markedly sclerotic. Rarefaction increasing. No periosteal reaction.

c, upper shaft with gross sequestra with early involvement of glenoid.
d, retracted. Head appears revascularized.

might prejudice their daughter's appearance. Instead they sought treatment elsewhere.

This treatment took the form of intensive x-ray therapy on a presumptive diagnosis of Ewing's tumor, employing only a single anterior portal over the upper arm. Symptoms were at first relieved but within a year the reaction to

excessive local x ray therapy caused sloughing of the skin and of the shoulder musculature as well as necrosis of the upper humerus (Fig 266). In the twelve years since that time, the patient has repeatedly returned to the clinic for reparative surgery, including partial resection of the humerus débridement of sloughing tendons and multiple skin grafts. Thoracic sympathectomy has been employed in a further endeavor to promote healing. Nevertheless one of the results has been a flail shoulder. Amputation is now under consideration.

Comment The exact diagnosis in this case will always remain in doubt, but the fact that the patient received only local irradiation and yet survived suggests that the original lesion was benign rather than malignant. The tragic results of ill advised and inept radiotherapy are obvious. These might have been averted, or at least minimized, by early exploration and biopsy, followed by treatment based on an accurate diagnosis.

CASE 2—This young man 17 years old was referred to the clinic in November 1946 because of nocturnal pain about the left knee and lower thigh. The patient stated that he had fallen on the left knee in September 1945 causing pain and swelling in the lower thigh, neither of which was disabling. Roentgenograms of the left knee taken at that time were reported to be negative. The swelling had persisted and had increased slowly in size. The pain originally mild and related to activity had become more severe and nocturnal in occurrence. In addition there had been a weight loss of 12 pounds in the two months preceding examination.

Physical examination disclosed that the patient was an asthenic youth in obvious pain who walked with a left knee limp. Active movements of the hips and knees were painless; there was no excess synovial fluid. The left lower thigh was found to be 3.0 cm. greater in circumference than the right, while the overlying skin was dusky in hue. A diffuse indurated mass which was not tender was found involving the lower femoral metaphysis and the overlying soft tissues. Roentgenologic examination revealed markedly increased density in the lower femoral shaft with an extracortical cuff of bony overgrowth arranged in a typical "sunburst" fashion (Fig 267). There was no evidence of metastases. Laboratory examination disclosed only a mild secondary anemia.

The patient was admitted to the hospital for biopsy which yielded a diagnosis of osteogenic sarcoma. A high thigh amputation was performed.

Comment The original x ray films of September 1945, obtained for comparison, revealed an osteolytic lesion involving the lower metaphysis of the left femur with bony spicules extending medially into the overlying soft parts even at that time. The price paid by this patient for the subsequent delay of fourteen months remains to be seen. A guarded prognosis has been given.

CASE 3—This patient, a 20-year-old girl, had gradually developed aching pain about the left patella six weeks before admission in November 1946. There was no history of antecedent injury. The severity of this complaint soon after its onset had led to her hospitalization elsewhere. Examination at that time which included even oxygen arthrography, appears to have been confined to the knee joint; the findings are said to have been negative. It was noted, however, that

lary destruction. The lungs and the other bones showed no evidence of metastasis. Laboratory examination was negative. A tentative diagnosis of sclerosing osteomyelitis was made and exploration was advised. It should be noted that the child was employed as a photographer's model. Her parents objected strenuously to any suggestion that an operation was necessary, on the grounds that it

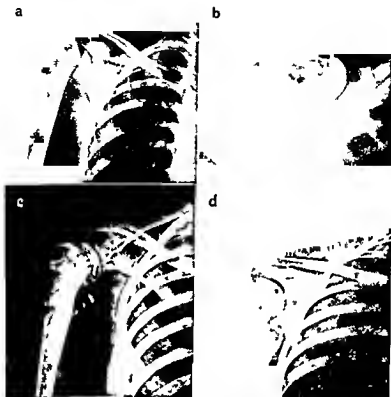


Fig. 266 (Case 1)—Necrosis of bone resulting from excessive irradiation.
a, June 1935. Sclerosis of cortex with early periosteal reaction. Central area of rarefaction.
b, November 1941. Epiphysis now fused. Shaft and head markedly sclerotic.

c, upper shaft with gross sequestra with early involvement of glenoid.
d, a resected. Head appears revascularized.

might prejudice their daughter's appearance. Instead, they sought treatment elsewhere.

This treatment took the form of intensive x-ray therapy on a presumptive diagnosis of Ewing's tumor employing only a single anterior portal over the upper arm. Symptoms were at first relieved but within a year the reaction to

nodes were enlarged bilaterally but were not tender. Roentgenologic examination proved equivocal, showing a destructive lesion of the shaft of the left femur posteriorly at the junction of the middle and lower thirds with local disruption of the cortex and proliferation of the periosteum (Fig 268). No soft tissue mass could be visualized. The lungs were clear. The sedimentation rate was 50 mm in one hour and white blood count 9900. The findings were believed compatible with either Ewing's tumor or osteomyelitis.

The patient was, therefore, hospitalized for a therapeutic trial on penicillin, the dosage being 40,000 units every three hours for five days. Since there was no appreciable response, operation was thought necessary. The involved bone was explored through a lateral approach using localizing roentgenograms taken in



Fig. 268 (Case 3)—Osteomyelitis. November 1946. Elevation and thickening of periosteum, slight thickening of cortex. Medullary canal irregular, with two central areas of rarefaction.

the operating room. Drilling of the cortex allowed the escape of thick greenish pus. Culture of this material subsequently yielded *Staphylococcus aureus* haemolyticus of a penicillin resistant strain. The routine treatment of osteomyelitis, decompression and primary closure was followed by sulfonamide therapy and resulted in complete relief of symptoms.

Comment. The clinical history and physical findings, which had been interpreted elsewhere as indicative of a knee joint affection, were not conclusive. The original radiographic examination had been restricted to a circumscribed area about the knee joint, with the result that the osteolytic lesion in the femoral shaft had not been visualized. Chemotherapy was finally selected as a differential measure, in prefer-

the patient did exhibit a low grade fever and mild leukocytosis. The case remained undiagnosed; the patient was reassured and discharged unimproved.

When the patient later came to the clinic, she stated that the pain had persisted, was increasing in severity and had become maximal by night. Further questioning disclosed that cellulitis of the left knee had developed in 1938, which had necessitated incision and drainage. In addition, she was said to have suffered

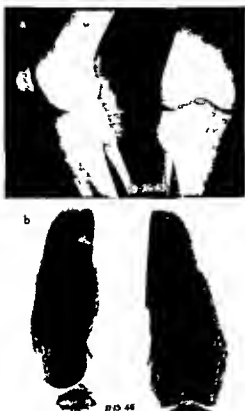


Fig. 267 (Case 2)—Osteogenic sarcoma. *a*, September 1945. Slight rarefaction in lower diaphysis. Very early radial spiculation visible along medial border. *b*, November 1946. Marked thickening of shaft. Obliteration of medullary canal. Characteristic "sunburst" appearance.

from "rheumatic fever" with joint involvement in 1941. She had been free from symptoms in the interim.

The patient appeared healthy, although she was found still to be running a daily fever of 99.6° F. Tenderness was elicited medially over the lower shaft of the left femur, where some thickening of the soft parts was palpable; no local mass was demonstrable, but a slight effusion was noted in the knee joint. There were no localizing signs otherwise in either knee or hip. The inguinal lymph

engorgement The exact site and size of the tumor, its outline, mobility, consistency and its relationship to overlying soft parts are all of importance In many cases, the diagnosis will by this time be apparent from evaluation of the history and physical findings

The laboratory procedures include radiographic, chemical, serologic and pathologic studies, of which at least the more important are available to the general practitioner Roentgenologic examination of the involved part necessitates stereoscopic views in at least two planes, while further information may be gleaned from variations in technic Films of the chest are essential, for we know that bone tumors in general tend to metastasize through the blood stream to the lungs, rather than through the lymphatic system The skull, spine, pelvis and any other bones indicated are likewise subjected to close scrutiny It has been our experience that the interpretation of the films in such cases may be exceedingly difficult Certainly, expert opinion should be sought before making a final diagnosis

Laboratory examination regularly comprises blood counts and serology Blood chemical estimates in regard to serum calcium, phosphorus, phosphatase or total protein may also be of value Tests for Bence Jones proteinuria are carried out if there is anything to indicate multiple myeloma

The final and probably the most reliable procedure at our disposal is microscopic examination of tissue sections In our experience specimens obtained by aspiration or punch biopsy are generally less dependable than the open method, for can be obvia niquets are neve

In this to long bones for biopsy Since amputation may prove unnecessary, consideration must be given to the future function of the limb Trauma to the soft parts and to the tumor itself should be reduced to a minimum for this reason, as well as to avoid the spread of tumor cells With this in view, the general principles of extensile exposure, first outlined by Henry in 1927, have been followed in this clinic with excellent results In brief, the value of the information to be gained from biopsy, in our judgment, far outweighs any risk to the patient

The efficacy of preoperative irradiation of proven bone tumors is still under investigation

SUMMARY

Realizing that these patients may present themselves to any practitioner, it is believed that every individual with persistent, unexplained bone of malignant graphic studie

ence to radiotherapy, because the latter was known to be capable of causing regression of symptoms in both osteomyelitis and Ewing's tumor. Penicillin therapy proved ineffectual only because of the specific nature of the organism.

and efficient treatment instituted

DISCUSSION

In order to avoid mistakes such as these, each such patient should be subjected to a complete diagnostic survey. These procedures have become more and more comprehensive in their scope with further refinements in laboratory techniques. Nevertheless, the basis on which every such survey is founded still lies in the clinical history and the physical examination.

Pain is, by all odds, the most important single complaint in bone malignancy, but a description of other symptoms, swelling, impairment of function and loss of weight must be elicited with care. Pain in a malignant bone tumor is usually constant and progressive. It is more noticeable by night, rather than on exertion. Swelling of the part, occurring somewhat later in the course of the disease, is also likely to increase steadily, although the rate may vary with the character of the neoplasm. Function may show impairment early, although this is by no means always the case.

The relationship of trauma to the onset of symptoms deserves mention. As was noted several years ago in osteogenic sarcoma particularly, many patients will give a history of an antecedent injury to the part. Furthermore in other types of tumor, the patient's attention may first be drawn to the area by reason of an injury, with persistence of the resultant symptoms. Careful inquiry is necessary regarding the onset, extent and severity of such symptoms as ecchymosis, swelling or tenderness. The physician should also note the relationship of these complaints to the present illness.

sizing to bone

Local examination of the affected part may reveal the presence of a visible or palpable swelling. It should be remembered that malignant bone tumors show a predilection for the ends of long bones near the epiphyseal lines where complexities of growth and function occur. Hence, the very location of the mass may arouse suspicion as should such phenomena as increased warmth or superficial venous

DIFFERENTIAL DIAGNOSIS OF CYSTIC LESIONS OF BONE

JAMES W. TOUMNEY

THERE are many modern aids in the diagnosis of cystic bone lesions, such as roentgenograms, blood chemistry and pathologic study of biopsy specimens. But in spite of all these helps, cases are seen which have been neither diagnosed nor treated. In still other cases, treatment has been instituted without benefit of a definite diagnosis. Because of the multiplicity of conditions which produce cystic lesions of

TABLE 1
CYSTIC LESIONS OF BONE

Osteomyelitis	Angioma series
Brodie's abscess or bone abscess	Angio-endothelioma
Fibrous dysplasia or osteitis fibrosa cystica or fibrocystic disease	Diffuse endothelium or Ewing's tumor
Bone cyst or latent or solitary bone cyst	Cavernous angioma
Polyostotic fibrous dysplasia (von Recklinghausen's disease)	Plexiform angioma
Hyperparathyroidism	Myeloma series
Albright's syndrome	Plasma cell (common form or multiple myeloma)
Osteitis deformans or Paget's disease	Myelocytoma
Monostotic Paget's disease	Erythroblastoma
Bone tumors	Lymphocytoma
Osteogenic sarcoma	Reticulum cell lymphosarcoma
Medullary and subperiosteal	Liposarcoma
Telangiectatic	Metastatic malignancy
Sclerosing	Breast
Periosteal	Prostate
Fibrosarcoma	Thyroid
Medullary	Xanthomatosis
Periosteal	Syphilis
Parosteal capsular	Tuberculosis
Chondroma series	Eosinophilic granuloma of bone
Chondrosarcoma	Lymphoblastoma or lymphoma
Myxosarcoma	Hodgkin's disease
Chondroma	Leukemia
Giant cell tumor series	Chloroma
Malignant	Osteoid osteoma
Epiphyseal giant cell tumor (benign)	Echinococcus of bone

bone, it is obviously important to make an early diagnosis so that the patient may receive adequate treatment.

When one sees the roentgenogram of the cystic bone lesion, a number of common lesions are immediately brought to mind in addition to some other conditions which must be considered (Table 1). Inspection of this table will show that an accurate diagnosis of a

doubt still exists as to the exact diagnosis, further laboratory investigations are necessary, of which by far the most important and most reliable is microscopic examination of tissue obtained at biopsy

REFERENCES

- 1 Henry, A. K. Exposures of long bones and other surgical methods New York, Wood, 1927, pp 80
- 2 Henry, A. K. Extensile exposure applied to limb surgery New York, Wood, 1945, pp 180

endothelioma which may have the roentgenographic features of osteomyelitis (Fig 269), and possibly the systemic reaction as well. A biopsy may be necessary to establish the exact diagnosis. In operating on patients with osteomyelitis bone should always be taken for pathologic section as well as for culture, to make sure that no tumor is present. An old chronic area of osteomyelitis may undergo "sarcomatous degeneration."

Brodie's Abscess or Bone Abscess—This is a small chronic, cystic lesion usually situated in the shaft of the tibia, femur or humerus, near the epiphysis.¹¹ The cyst is surrounded by a wall of reaction denser than the normal bone which is visible by roentgenogram and



Fig 270—Brodie's abscess of hum

aids in identification (Fig 270). The outstanding symptom is pain which may be severe and we are reminded that in 1824 Sir Benjamin Brodie treated the first recognized case by amputation of the leg. After the onset of pain, swelling and a low grade inflammatory reaction in the soft tissue may appear. There is frequently a history of antecedent infection. The staphylococcus is the most common causative organism after trauma.

bone cysts

cystic bone
and
periosteal

comparable lesions. In this paper I have excluded the bone lesions which are predominantly bone forming or mainly deforming rather than cystic.

Osteomyelitis—The diagnosis of this condition is usually not difficult. It is in the early cases alone that we see bone destruction with



Fig. 269.—Chronic osteomyelitis of humerus

out bone proliferation or sequestration, and in these early cases the pain, the systemic reaction with fever, leukocytosis and elevation of

bone production around the destroyed areas and in many cases the process goes on to sequestration. One must be on guard against Ewing's

fibrosa in which only one bone is involved. If the changes are confined to one limb the condition is known as monomelic.

Hyperparathyroidism is characterized by multiple bone cysts and in addition renal calculi are frequent. Hyperparathyroidism is a chronic fulminating disease of middle adult life more commonly seen in females than in males.⁴⁰⁻⁵⁰ Osteoporosis is present to a varying degree.⁵³ It may be so severe that vertebral collapse producing kyphosis takes place.⁴¹ In hyperparathyroidism the serum calcium is high ranging from 10 to 15 or 16 mg per 100 cc.³⁸⁻³⁹ and the serum phosphorus is low varying from 1.7 to 3.6 mg per 100 cc. A serum phosphorus below 3.5 mg and a serum calcium above 11 mg should be regarded with suspicion.¹ The plasma phosphatase may range from 3 to 36 Bodansky units. There is a negative calcium balance producing loss of calcium through the urine as is evidenced by a positive Sulkowitch test. Hyperparathyroidism is caused by parathyroid tumors and therefore the treatment is surgical exploration of the neck. There is a secondary form of hyperparathyroidism characterized by hypertrophy of the parathyroid in the absence of tumor secondary to chronic renal disease.

Other conditions causing cystic lesions such as multiple myeloma and metastatic malignancy also may have a high serum calcium. However in these latter conditions the serum phosphorus is elevated too.

Ollier's Disease⁵¹—Another condition giving rise to cysts and abnormal new bone formation with marked deformity in size and shape of the bones is Ollier's disease or Ollier's dyschondroplasia.⁷ This is a disturbance of ossification usually affecting one lower extremity as described by Ollier in 1899.⁴⁷ It is an intrinsic disturbance of ossification with the formation of chondroma like tumor masses known as skeletal enchondromatosis which has a tendency to attack one side of the body.

Albright's Syndrome—Another entity which has been separated from the large and confused fibrocystic disease group is known as Albright's syndrome.⁷ In these cases multiple bone cysts are accompanied by skin pigmentation and endocrine dysfunction. In this condition the cysts have a strong tendency to be unilateral.

Osteitis Deformans or Paget's Disease⁵²—This condition is an osteitis usually multiple which is characterized by a bone deformity consisting of broadening and bending of the bones accompanied by bone destruction and new bone formation. The roentgenogram shows a blurred appearance of the thickened skull which is very typical. A single focus of the disease in a single bone is known as monostotic Paget's disease. Paget's disease is most frequently found in the tibiae which are commonly bowed anteriorly. It occurs in the middle and older age groups and is very slowly progressive.

The alkaline-serum phosphatase the normal level of which in adults

Bone Cysts—The solitary bone cyst is a common lesion usually found in the shaft of the long bones of older children and in young adults^{36 40 64} This is a form of *osteitis fibrosa cystica*,^{3 16} related to bone formation and is an abnormality in the development of the bone. The most frequent location is in the upper shaft of the femur, the humerus or the tibia. The symptoms are mild or even absent. By roentgenogram, these cysts have coarse trabeculations, and frequently expand the cortex of the bone. The cortical shell is smooth and intact unless fractured. These lesions are likely to be confused with Brodie's abscess, giant cell tumor, chondroma and also the osteolytic malignant bone tumors. The patient with a bone cyst usually comes to the doctor because of a fracture involving the cyst, and frequently the smaller cysts will heal without surgical intervention after such trauma. Sometimes in later life, a bone cyst which has not produced symptoms is discovered incidentally in the course of a roentgenologic examination. It is then recognized as a latent bone cyst.

Multiple Bone Cysts—Many conditions are gradually being classified from this very confused group of fibrocystic conditions. The most common and all inclusive term is fibrocystic disease. It is also known as a multiple form of *osteitis fibrosa cystica*. In addition, it is known as von Recklinghausen's disease as a number of such cases were described by him in 1891. Included in his series were also cases which in the light of present knowledge we now know had multiple bone cysts because of hyperparathyroidism. Lichtenstein and Jaffe⁴² have attempted to clarify the nomenclature by coming a new term, namely, polyostotic fibrous dysplasia. This term is used by them to denote a skeletal developmental anomaly affecting several or many bones with predominantly unilateral involvement. It is found in childhood, and pain, deformity, and a tendency to pathologic fracture are the outstanding signs and symptoms. They note the bewildering multiplicity of titles used for this condition by various authors, such as *osteodys-trophia fibrosa unilateralis*, *unilateral polyostotic osteitis fibrosa*, *uni-*

the fibrous
dysplasia may be differentiated from hyperparathyroidism because the latter does not occur in childhood and is not unilateral. Also in

fibrosa in which only one bone is involved. If the changes are confined to one limb the condition is known as monomelic.

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The alkaline-serum phosphatase the normal level of which in adults

is 15 to 4 Bodansky units—the average being 25, is usually greatly elevated

In the solitary polyostotic Paget's, the phosphatase may range from 50 to 125 Bodansky units. Thus, the phosphatase is frequently of diagnostic importance

The serum calcium and the serum phosphatase are normal or are

Bone Tumors.—OSTEOGENIC SARCOMA (See Table 1 for the varieties as classified by the Registry)^{13 14 15} Osteogenic sarcomas belong in the discussion of cystic lesions because they are frequently osteolytic and, moreover, even the sclerosing, bone producing type shows osteolytic mottling in the shaft of the bone very often in both the early and the later stages. The medullary is the typical form which produces the triangle of Codman by roentgenologic examination. The telangiectatic form is the so called malignant bone aneurysm. The sclerosing osteogenic sarcoma described by Virchow is found in the younger age groups and is perhaps the most typical and well known malignant bone tumor, characterized by large, dense, irregular masses of bone, which have the "sun ray" appearance. It usually occurs on the shaft side of the epiphyseal line, commonly near the end of the long bone with pain as an early symptom. In these rapidly growing tumors leukocytosis and fever may be present, as well as elevation of the alkaline phosphatase. This is increased in any bone tumor in which there is definite bone production. Biopsy should be done to make the

chief roentgenographic feature. Coarse trabeculations may be present thus causing confusion with the giant cell tumor. In youth, these tumors may cross the epiphyseal line. The osteolytic tumors characteristically extend through the cortical bone rather than expanding the cortex. As these malignant bone tumors are usually found in the younger age groups, this helps to differentiate them from metastatic malignancy. These osteolytic malignant bone tumors are most fre-

bone and in this way may be differentiated from the benign lesions, depending to a certain extent on malignancy and rate of growth

Fibrosarcoma of bone is classified under the osteogenic series. Fibrosarcoma may arise from fibroblasts within the bone or may invade from the periosteum or soft tissue outside the bone giving the appearance of a primary destructive lesion of bone. These tumors usually occur in adult life and are more frequent in the lower femur and the upper tibia. There is no typical roentgenologic appearance. Usually the soft tissue shadow outside the bone is relatively large and frequently has the appearance of a metastatic malignancy. Only the pathologist can make the differential diagnosis.

CHONDROMA SERIES—*Chondrosarcoma* is a malignant tumor which is frequently very bulky. It is characterized by opaque calcific deposit and there are many grades of malignancy (Fig 271).



Fig 271 Primary chondrosarcoma of hum. Note similarity to Brodie's abscess in Figure 272.

Some benign medullary tumors are of the giant cell type but contain myxosarcomatous structure and are classified as mixed cell sarcoma. There are many gradations between these and the giant cell tumors.

Chondroma—Chondromas are benign tumors²³ cystic in appearance usually occurring in the small bones of the hands and feet.²² They often expand the cortex and the larger ones are usually located at the sternum. Multiple chondromas involving the hands and feet are common and these may be cartilaginous fetal rests. There is a close relationship with Ollier's disease, chondrodysplasia and multiple enchondromas.²⁴

GIANT-CELL TUMOR SERIES—Malignant—The malignant variation of

on every accessible giant cell tumor to establish an accurate diagnosis

Epiphyseal Giant cell Tumor or Benign Giant cell Tumor—This is a cystic lesion of the epiphyses, the lower end of the femur being frequently involved.^{8, 23} It is found in young adults¹ and may reach a large size, greatly expanding the cortex and leaving coarse trabeculations within, giving a multiloculated appearance⁴⁸ (Fig 272) Type



Fig 272—Benign giant-cell tumor of femur having eroded cortex, not showing typical trabeculations

cally, great bone expansion is present. These tumors are so called because they contain many large multinucleated giant cells. In the

The giant-cell tumors develop at the end of the shaft of the long bone. The tumors may pulsate or yield a bruit, all grades of malignancy may be found in the giant-cell tumor series.

ANGIOMA SERIES—*Angioma* or *hemangioma* of bone may be cavernous or plexiform. These tumors may produce an unusual soap bubble effect in the roentgenogram, with coarsely multiloculated areas of expansion, all on the shaft side.

Angio endothelioma—This is a rare condition and very few have been described in the literature.

Diffuse Endothelioma or *Ewing's Sarcoma* or *Endothelioma* or *Endotheliomyeloma*—This tumor is also often referred to as Ewing's tumor. It is a very malignant tumor of bone, usually arising in the shaft in children and young adults. There is frequently a history of trauma. Pain is the chief presenting symptom. The long bones, tibia, femur, and humerus are most frequently involved. The greatest dif-

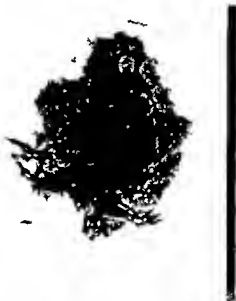


Fig 273—Multiple myeloma. Typical "punched out" areas in skull.

iculty in diagnosing this deadly disease is its similarity to osteomyelitis. The roentgenogram may suggest osteomyelitis and the patient may have pain, local heat, swelling, tenderness, redness with fever, leukocytosis and elevation of the sedimentation rate, all suggesting osteomyelitis. The typical roentgenologic findings of Ewing's tumor are thickening and increased density of the shaft but mottling of the bone may be present suggesting a cystic lesion. The accepted treatment is amputation in the lower extremity and resection in the upper extremity plus radiotherapy. The tumors are very sensitive to irradiation and this has been used as a diagnostic feature. Of the tumors, lymphosarcoma and chondromyxosarcoma may simulate Ewing's endothelioma. Early biopsy for diagnosis should be performed.

MYELOMA SERIES—Plasma Cell—This represents the well known clinical condition known as *multiple myeloma*.⁶ Whether the myeloma is of the plasma cell type or myelocytoma or erythroblastoma or lymphocytoma is not of importance to the pathologist of multiple myeloma.⁴⁹ These lesions (Fig 273) found in the older age group, which may be very small or range in size to approximately 10 cm in diameter. They tend to be round or oval. They are found in the age group where one would expect to find skeletal metastases. Soft, tender masses over the ribs and sternum are frequently palpable, which aids in the diagnosis. A large percentage is between 40 and 60 years of age, and spinal collapse may be so severe that kyphosis has taken place. The blood picture shows progressive anemia and the serum calcium may be moderately increased.

The presenting symptom is pain. Pathologic fractures are frequent and these tumors may lead to spinal collapse. The spine, ribs and sternum are most frequently involved. The predominant bone picture is one of multiple, small, irregular, destructive lesions without reaction. Biopsy is often necessary for diagnosis. Bence Jones bodies occur in the urine of from 50 to 80 per cent of the cases and thus aid in diagnosis. The only treatment is deep irradiation which may ease the pain or slow the progress of the disease.⁵⁵

Solitary myelomas^{53, 64} occur rarely and are a difficult problem in diagnosis requiring biopsy. Up to 1943 there were only 48 cases of the so called solitary myelomas in the literature. The solitary type may become multiple.²³

For the diagnosis of myeloma an asexual spinal fluid tap, an asexual bone marrow puncture before roentgenogram.⁴⁶ Bence Jones protein is present in only 20 per cent of the solitary forms. The solitary form may simulate a giant cell tumor or may be a purely destructive lesion.

RETICULUM-CELL LYMPHOSARCOMA—This is a rare tumor of bone characterized by bone destruction. It may be far advanced before a diagnosis of tumor is made. The lymphosarcomas of bone are a heterogeneous group, more or less clearly defined.

LIPOSARCOMA—This very rare tumor, osteolytic in type, has been described by Stewart.⁶³

METASTATIC MALIGNANCY—Metastatic cancer in bone is most frequently osteolytic but may be osteoblastic, and both types of metastases may arise from the same primary growth. Metastases may be solitary in bone, or multiple and give rise to a multiplicity of clinical pictures.¹⁹

Carcinoma of the breast is responsible for the greatest number of bone metastases. These are usually found in the middle aged group.

The spine and pelvis are the bones most frequently affected and the pain may first simulate the pain of arthritis.⁴⁷ Carcinoma of the prostate is the most frequent cause of metastatic lesions in the male. They are usually found in the pelvis and the spine and have a very typical roentgenographic appearance with multiple areas of destruction of various sizes with osteoplastic areas of increased density interposed. Bone metastases occur from carcinoma of the thyroid and also from hemangioendothelioma. Bone metastases from other sources such as the gastrointestinal tract, are most unusual.

In general metastatic foci give rise to severe constant pain unrelieved by salicylates or recumbency. These metastatic foci are most easily confused with bone cyst, multiple myeloma and the osteolytic form of osteogenic sarcoma.⁴⁸ Metastases may give rise to symptoms before the primary growth itself and this fact explains the importance of a complete physical examination with special emphasis on breast, thyroid and prostate. In prostatic carcinoma the acid phosphatase as well as the alkaline phosphatase is elevated which is a valuable point in the differential diagnosis.

Xanthomatosis is a condition in which accumulations of lipid substance appear in various locations in the body. This descriptive term was given by Rowland.⁴⁹ Several distinct clinical entities are included under this term.

Schuller-Christian's disease is a form of xanthomatosis also known as lipid histiocytosis⁵⁰ of young children characterized by the following: (1) involvement of the bones of the skull, (2) diabetes insipidus, (3) exophthalmos and (4) gingivitis. This condition is fatal in about one-third of the cases.

Niemann-Pick's disease is a congenital familial constitutional condition which is a form of xanthomatosis with enlargement of the spleen and liver and is peculiar to infants of the Jewish race.^{47, 50}

Gaucher's disease or Gaucher's splenomegaly is a form of xanthomatosis. This is a rare familial disease of lipid metabolism found in childhood which runs a chronic course and is characterized by enlargement of the spleen, liver and lymph nodes and with bone changes especially in the femur, pelvis and spine.⁵¹ The bones involved show cortical thinning and medullary areas of erosion of the trabeculae (Fig. 274). Bone deposits are formed principally around the hip joint.⁵² The form that is most likely to be

The lesions are usually multiple. The luetic changes in bone have been found as early as the fifth fetal month. These changes are usually in the long bones and the tibia is the most frequent site. Single foci are rare. In older children the lesions are not so typical and here syphilis is "the great imitator." Fifty per cent of children with congenital syphilis have osseous involvement.⁵³

MYELOMA SERIES—Plasma Cell—This represents the well known clinical condition known as multiple myeloma.

the pathologist. The plasma-cell type is the commonest form of multiple myeloma.⁴³ It is characterized by multiple, cystic, "punched out" lesions (Fig 273) found in the older age group, which may be very small or range in size to approximately 10 cm in diameter. They tend to be round or oval. They are found in the age group where one would expect to find skeletal metastases. Soft, tender masses over the ribs and sternum are frequently palpable, which aids in the diagnosis. A large percentage is between 40 and 60 years of age, and spinal collapse may be so severe that kyphosis has taken place. The blood picture shows progressive anemia and the serum calcium may be moderately increased.

The presenting symptom is pain. Pathologic fractures are frequent and these tumors may lead to spinal collapse. The spine, ribs and sternum are most frequently involved. The predominant bone picture

is osteolytic. The only treatment is deep irradiation which may ease the pain or slow the progress of the disease.⁴⁵

Solitary myelomas^{43, 44} occur rarely and are a difficult problem in diagnosis requiring biopsy. Up to 1943 there were only 48 cases of the so-called solitary myelomas in the literature. The solitary type may become multiple.⁴⁵

Sternal puncture is an outstanding aid in the diagnosis of myeloma and this diagnosis has been established by sternal puncture before any bone changes became visible in the roentgenogram.⁴⁶ Bence-Jones protein is present in only 20 per cent of the solitary forms. The solitary form may simulate a giant cell tumor or may be a purely destructive lesion.

RETICULUM-CELL LYMPHOSARCOMA—This is a rare tumor of bone characterized by bone destruction. It may be far advanced before a diagnosis of tumor is made. The lymphosarcomas of bone are a heterogeneous group, more or less clearly defined.

LIPOSARCOMA—This very rare tumor, osteolytic in type, has been described by Stewart.⁴⁷

solitary in bone, or multiple and give rise to a multiplicity of clinical pictures.⁴⁸

Carcinoma of the breast is responsible for the greatest number of bone metastases. These are usually found in the middle aged group.

The spine and pelvis are the bones most frequently affected and the pain may first simulate the pain of arthritis.⁶⁷ Carcinoma of the prostate is the most frequent cause of metastatic lesions in the male. They are usually found in the pelvis and the spine and have a very typical roentgenographic appearance with multiple areas of destruction of various sizes with osteoplastic areas of increased density interposed. Bone metastases occur from carcinoma of the thyroid and also from hypemephroma. Bone metastases from other sources such as the gastrointestinal tract are most unusual.

In general metastatic foci give rise to severe constant pain unreheved by salicylates or recumbency. These metastatic foci are most easily confused with bone cyst, multiple myeloma and the osteolytic form of osteogenic sarcoma.⁶ Metastases may give rise to symptoms before the primary growth itself and this fact explains the importance of a complete physical examination with special emphasis on breast, thyroid and prostate. In prostatic carcinoma the acid phosphatase as well as the alkaline phosphatase is elevated which is a valuable point in the differential diagnosis.

Xanthomatosis is a condition in which accumulations of lipid substance appear in various locations in the body. This descriptive term was given by Rowland.⁵⁵ Several distinct clinical entities are included under this term.

Schuller-Christian's disease is a form of xanthomatosis also known as lipid histiocytosis⁶⁰ of young children characterized by the following: (1) involvement of the bones of the skull, (2) diabetes insipidus, (3) exophthalmos and (4) gingivitis. This condition is fatal in about one third of the cases.

Niemann-Pick's disease is a congenital familial constitutional condition which is a form of xanthomatosis with enlargement of the spleen and liver and is peculiar to infants of the Jewish race.^{47, 60}

Gaucher's disease or Gaucher's splenomegaly is a form of xanthomatosis. This is a rare familial disease of lipid metabolism found in childhood which runs a chronic course and is characterized by enlargement of the spleen, liver and lymph nodes and with bone changes especially in the femur, pelvis and spine.⁶⁵ The bones involved show cortical thinning and medullary areas of erosion of the trabeculae (Fig. 274). Bone deposits are formed principally around the hip joint.⁵⁷ The disease is a form of xanthomatosis.

the form that is most likely to be

The lesions are usually multiple. The luetic changes in bone have been found as early as the fifth fetal month. These changes are usually in the long bones and the tibia is the most frequent site. Single foci are rare. In older children the lesions are not so typical and here syphilis is "the great imitator." Fifty per cent of children with congenital syphilis have osseous involvement.⁶⁶

In acquired syphilis the lesions are not typical of any one condition.⁶³ They may be like osteomyelitis or any of the lesions, like gummas. Cystic areas may be present, and also syphilitic dactylitis is not uncommon. The gummas may erode the entire width of the shaft, leading to pathologic fracture, and also ulceration and sinus formation may take place.⁶¹

Diaphyseal Tuberculosis.—Cystic tuberculosis may occur in the shaft of the long bones.²³ It is becoming a rare entity, even more so than joint tuberculosis. In this country, now that most milk is pasteurized, these lesions are not commonly seen. Diaphyseal tuberculosis may be single or multiple. The cystic areas are usually oval in shape



Fig. 274.—Gaucher's disease. Unusual site of involvement in humerus.

is chronic, sequestration may occur. The Mantoux test is valuable when it is negative in ruling out the tuberculous lesion. A positive diagnosis is made by biopsy and guinea pig inoculation. Cystic areas of tuberculosis may occur near the ends of long bones secondary to and as a direct extension from joint tuberculosis. Because of the adjacent joint tuberculosis, the diagnosis of these conditions is not difficult.

Eosinophilic Granuloma of Bone.—This is a single or multiple cystic, nonexpanding osteolytic lesion of bone in children.^{29, 43} The lesion is of the inflammatory type but no organisms have been cul-

tured¹² It is infrequent in females, is most common in the young age group, and is usually solitary¹¹ Pain, swelling and tenderness are usual It is characterized by a round or oval nucleus of decreased density, sharply demarcated¹⁵ Lichtenstein and Jaffe first described it For diagnosis, biopsy is indicated

Lymphohlastoma and Lymphoma.—This is the general term for ease and lymphosarcoma

Granuloma or Lymphogranuloma
= cystic destructive lesions of bone,
agnosis of Hodgkin's disease in most

cases is made by lymphatic enlargement before the bone lesions are



Fig 275—Osteoid osteoma of tibia proven by section

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istically seen in the spine, pelvis and ribs They are predominantly destructive and may lead to vertebral collapse Irradiation usually affords marked symptomatic relief⁴ Changes in the peripheral blood stream are not constant in Hodgkin's disease

Leukemia—The roentgenologic evidence of bone changes in leukemia are variable and nonspecific.⁹ There are signs of bone destruction, expansion of the marrow cavity, atrophy of the cortex, demineralization, and new bone formation parallel to the shaft in several long bones. Sternal puncture may be required for diagnosis. Destructive bone changes are rarely seen in leukemia in only perhaps 4 per cent of the cases. The lesions may produce bone pain which draws attention to them. The leukemic bone changes are more common and also more varied in children than they are in adults.²¹

Chloroma—Chloroma or chloroleukemia²² is a rare disease which is a variant of myelogenous leukemia with formation of green tumors. It was called chloroma by King in 1853²³ who described the greenish tumors of the skull and orbital regions, usually in children, with a rapid downhill course.²⁴ It may also occur in adults.

Osteoid Osteoma—This is a benign bone lesion of unknown etiology, producing pain and at times swelling which is found solitary in bones of the skull, spine and extremities.²⁵ It is characterized by a small, round or oval area of rarefaction of bone, with condensation in the center, and the adjacent bone is sclerosed usually to a great depth and extent, making sclerosis the most typical part of the lesion (Fig. 275).

Echinococcus of Bone.—These polycystic without productive reaction.¹⁰ The surrounding bone is thinned and expanded. The intradermal test is valuable in the diagnosis.²⁶ The echinococcus disease forms hydatid cysts which may be in the bone. Human beings contract this disease from dogs. Most echinococcus infections in man are found in the liver, and the bones are very rarely invaded. In the bone lesions many cysts are formed. The fluid should be examined for scolices, or hooklets which may or may not be present. The cyst walls show concentric ring formation which is a characteristic of osseous hydatid cyst. The complement fixation test and the Casoni or skin sensitivity reaction are valuable.

SUMMARY

Many are the factors which must be taken into account in the diagnosis of cystic lesions of bone. In the history of the case the knowledge of antecedent infection or injury is important as these may suggest osteomyelitis. Also in many bone tumors there is an antecedent history of injury. In some of the rarer conditions such as Gaucher's disease, the family history is of value. It is pertinent to know if the patient has had a systemic reaction which is frequently present in The symptom of severe night un of malignant disease from

In the examination to discover if other parts and other bones have been infected. Is the lesion single or multiple? After

metastasis has been found further examination may disclose the primary lesion in the breast, prostate or thyroid, or a pyelogram may disclose a hypernephroma. The examination of the lymph nodes of the liver and of the spleen is helpful in the lymphoblastoma and leukemia groups as well as in syphilis and hydatid disease. Kyphosis found on examination may lead to a diagnosis of metastatic malignancy, multiple myeloma, Hodgkin's disease or hyperparathyroidism.

If additional lesions are suspected other bones should be examined roentgenographically. I feel confident that in some future day routine roentgenograms of the entire skeleton will be taken probably on miniature film just as chest roentgenograms are common practice today in large groups of patients. If metastatic malignancy is suspected it is especially important to make roentgenograms of the chest for evidence of pulmonary metastases.

In urinalysis it is important to look for Bence Jones proteins to aid in the diagnosis of multiple myeloma and also a Sulkowitch test should be done to help determine the negative calcium balance when hyperparathyroidism is suspected.

Regarding the blood the serum calcium (the normal being 7 to 10 mg per cent) is elevated in a number of these conditions particularly in hyperparathyroidism.

The serum phosphorus is altered in certain cystic conditions the normal in adults being from 3 to 4 mg per cent and in children 5 to 5.5 mg per cent. The phosphorus is notably low in hyperparathyroidism. The alkali serum phosphatase the normal of which in adults is from 20 to 90 Bodansky units is characteristically raised in lesions in which ossification is taking place most dramatically so in polyostotic Paget's disease. The serum acid phosphatase of which the normal is 0 to 12 units is especially valuable in the diagnosis of prostatic metastases in which this acid phosphatase is elevated. For example in osteitis fibrosa and in carcinoma of prostatic metastases the alkali phosphatase is elevated whereas the acid serum phosphatase is elevated in carcinoma of the prostate with metastases only.

Intradermal tests are valuable in conditions such as tuberculosis and of course it is hardly necessary to mention the importance of the blood and if necessary the spinal fluid findings in syphilis.

A final aid in the differential diagnosis of cystic lesion of bone is the response of these lesions to radiotherapy which the patients may have had previously. Warren⁶⁹ divides the radiosensitivity of tumors into three groups. In the first radiosensitive group are the lymphoma, chronic leukemia and Ewing's tumor of bone. In the second or radio-responsive group are many soft tissue tumors and in the third radio-resistant group is the osteogenic sarcoma.

In conclusion the chief diagnostic features of these various cystic bone lesions have been described because a definite diagnosis is of paramount importance before accurate treatment can be instituted.

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THE SURGICAL CLINICS of NORTH AMERICA

MAYO CLINIC NUMBER

SYMPOSIUM ON GYNECOLOGY

CARCINOMA OF THE UTERUS

JAMES C. MASSON

WHILE the lives of more women who have carcinoma of the uterus are being saved at present than formerly, the fact remains that the number of deaths from uterine cancer is increasing. In 1942 there were 16,893 deaths in the United States due to cancer of the uterus according to official vital statistics.⁴

At the Clinic one case of carcinoma of the body of the uterus is encountered for every 2.4 cases of carcinoma of the cervix.

ETIOLOGY

The etiology of carcinoma is still unknown and, until it is recognized, there is little hope of much change in the present day gloomy prognosis. Familial tendency, or at least an increased susceptibility to the disease in some families, has long been recognized. Chronic irritation from various agents has been accepted as a predisposing cause. Frequent child bearing has been suggested as a predisposing cause in some cases, but it is a fact that many spinsters and barren married women die of the disease.

DIAGNOSIS

The only hope for cure lies in early diagnosis and early institution of modern methods of treatment. Positive diagnosis can be made only from microscopic examination of tissue and for that reason, I think one of the most important considerations in a modern program of medical education should be to influence more young men to become competent pathologists. Furthermore, all medical men should be ever on the lookout for symptoms suggestive of malignancy and impress their patients with the necessity of early, thorough examination at the least suspicion of any change in the menstrual history or in the char-

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acter of the vaginal secretion. In recent years a great deal has been done to educate the laity as to the importance of early diagnosis and the necessity not only for visual examination of the cervix but also, in all suspicious cases, for removal of tissue for microscopic examination. Most patients now expect and appreciate a complete examination by their physician.

With modern methods of treatment, early recognition of a carcinomatous growth is most important. A large majority of cases in which there is survival for five years or more after treatment are those in which the growth was simply a local condition. If treatment is not instituted when the condition is still confined to the uterus but is delayed

TABLE 1

MALIGNANT LESIONS OF THE CERVIX: DISTRIBUTION BY GRADE OF MALIGNANCY (BRODERS) AND BY TYPE OF TREATMENT 1910-1944

Grade	Total		Treated Surgically*		Treated Nonsurgically†	
	Number	Per Cent	Number	Per Cent	Number	Per Cent
1	71	2.5	36	6.5	35	1.6
2	414	14.8	106	19.0	308	13.7
3	1,321	47.2	206	46.0	1,065	47.5
4	994	35.5	159	28.5	835	37.2
Total	2,800	100.0	507	100.0	2,243	100.0
Not stated	1,162		427		735	
Total	3,962		984		2,978	

* Operation with or without radiotherapy

† Radiotherapy alone

until the disease has spread to adjacent organs or has been carried by

from normal cell structure and arrangement, are classed "grade 1" From 1910 to 1944 inclusive, 1 694 cases of carcinoma of the uterine body and 3 962 cases of carcinoma of the uterine cervix were encountered at the Clinic, distributions as to grade of malignancy and as to type of treatment are shown in tables 1 and 2

What was said in a previous paper¹ is still true "Many pathologists do not place much value on the grading of malignant tissue and contend that sections from different parts of a single growth will suggest different degrees of malignancy It has been said that tissue taken at different times may show various percentages of differentiation of the cells There is no doubt that changes do take place and various

TABLE 2

MALIGNANT LESIONS OF THE BODY OF THE UTERUS DISTRIBUTION BY GRADE OF MALIGNANCY (BRODERS) AND BY TYPE OF TREATMENT 1910-1944

Grade	Total		Treated Surgically*		Treated Nonsurgically†	
	Number	Per Cent	Number	Per Cent	Number	Per Cent
1	337	34.2	314	35.8	23	21.5
2	378	38.4	349	39.7	29	27.1
3	129	13.1	102	11.6	27	25.2
4	141	14.3	113	12.9	28	26.2
Total	985	100.0	878	100.0	107	100.0
Not stated	709		544		165	
Total	1 694		1 422		272	

* Operation with or without radiotherapy

† Radiotherapy only

factors like infection, degeneration and so forth influence the microscopic picture After trial in a very large series of cases, however, we are satisfied that the method is of real prognostic value and we rely on it a great deal There is no doubt that the training and personal equation of the pathologist are most important in evaluating the method"

The classification of Schmutz, which takes into account the amount of local involvement, has been accepted by many gynecologists, it is a useful, but by no means accurate, method of tabulating cases According to this classification apparently early lesions are grouped in stage 1, stages 2 and 3 include more advanced lesions and stage 4 represents the most advanced, hopeless lesions The physician, how

ever, must not be misled by fixation of the uterus or infiltration into the broad ligaments, as this may be a result of coexisting inflammatory disease or endometriosis and as malignant tissue in the vaginal vault can be removed satisfactorily along with the uterus. On the other hand, it is not at all uncommon at the time of operation performed for removal of a small (stage 1) cervical lesion to find extension into the broad ligaments and involvement of the lymph nodes in the obturator space without any suggestion of uterine fixation on bimanual examination.

PROGNOSIS

The extent of the local growth is no doubt of great importance from a prognostic standpoint and as an indication for treatment, but it does not represent as good a guide to the ultimate outcome as does

TABLE 3

MALIGNANT LESIONS OF THE CERVIX FIVE YEAR SURVIVAL RATES BY GRADE OF MALIGNANCY (BRODERS) AND BY TYPE OF TREATMENT

Grade	Treated Surgically*				Treated Nonsurgically†			
	Patients‡		Lived Five or More Years after Operation		Patients‡		Lived Five or More Years after Treatment	
	Total	Treated	Number	Per Cent of Treated Patients	Total	Treated	Number	Per Cent of Treated Patients
1 and 2	197	86	61	70.9	259	222	84	37.8
3 and 4	298	252	126	50.0	1,308	1,171	408	34.8
Not stated	40*	391	117	29.9	690	653	111	16.9
Total	807	729	304	41.7	2,337	2,046	603	29.4

* Operated on with or without radiotherapy

† Radiotherapy alone

‡ Inquiry as of January 1, 1945. Included are only those patients operated on or treated five or more years prior to the time of inquiry that is 1939 or earlier. The hospital deaths are omitted from the calculations.

the histologic appearance of the predominant cells. Experience has

paper, means treatment with roentgen rays or radium or both) For tumors which are resistant to radiotherapy radical surgical removal

malignant tumors and, except at a very early stage, are difficult to cure by surgical measures alone

While 41.7 per cent of traced patients who had had malignant lesions of the cervix (all grades) were cured by surgical removal with or without radiotherapy, only 29.4 per cent were cured by radiotherapy alone (table 3). In cases in which the lesion was primary in the body of the uterus, 68.7 per cent of traced patients were alive and well five years or more after surgical removal of the lesion but only 21.3 per cent of traced patients survived five years when only radiotherapy had been used (table 4).

The radiotherapy alone

with roentgen rays or radium alone was considered inoperable and

TABLE 4

MALIGNANT LESIONS OF THE BODY OF THE UTERUS FIVE YEAR SURVIVAL RATES BY GRADE OF MALIGNANCY (BRIDGERS) AND BY TYPE OF TREATMENT

Grade	Treated Surgically*				Treated Nonsurgically†			
	Patients‡		Lived Five or More Years after Operation		Patients‡		Lived Five or More Years after Treatment	
	Total	Traced	Number	Per Cent of Traced Patients	Total	Traced	Number	Per Cent of Traced Patients
1 and 2	399	288	226	78.5	33	29	6	20.7
3 and 4	110	90	45	50.0	33	27	5	18.5
Not stated	50	490	325	66.3	150	141	31	22.0
Total	1014	868	596	68.7	216	197	42	21.3

* Operation with or without radiotherapy

† Radiotherapy alone

‡ Inquiry as of January 1, 1945. Included are only those patients operated on or treated five or more years prior to the time of inquiry that is 1939 or earlier. The hospital deaths are omitted from the calculations.

only palliation was attempted. It must be kept in mind, in evaluating statistics such as these, that many of the patients were treated before the value of roentgen rays and radium was recognized and when radical operations were attempted in the more advanced cases.

While I have never made a practice of doing a Wertheim type of hysterectomy for a malignant lesion of the uterine body, from the

statistical analysis of the lesions

(grade 3 or grade 4) growth, it shows a marked tendency early to extend to the parametrium and to the lymph nodes and it occurs most frequently in middle-aged women. On the other hand, carcinoma of the uterine body is almost always adenocarcinoma, it occurs at a slightly greater

age than does carcinoma of the cervix and in more than two-thirds of the cases it is a grade 1 or grade 2 lesion

SYMPTOMS

The early symptoms of uterine carcinoma are much the same whether the growth is primary in the cervix or in the body of the uterus and are uniformly listed in most papers on the subject as (1) irregular vaginal bleeding (2) foul watery discharge and (3) pain. Unfortunately these are the symptoms of a well advanced lesion in most cases not the symptoms of a growth that is still operable. Any one sign such as irregular spotting of blood between menstrual periods or after the menopause indicates the need for examination of tissue by a competent pathologist. Unfortunately during the course of a general examination or at the time of an operation a well advanced malignant lesion frequently is found that had apparently given no symptoms which the patient's medical adviser had considered suggestive of a malignant growth. This is especially true of malignant growths of the uterine body but cases are encountered occasionally in which the lesion is well inside the cervical canal and the vaginal part of the cervix is not involved.

TREATMENT

In any case in which carcinoma is suspected the important consideration is to get the patient under treatment as soon as possible. After a thorough medical check to determine whether the surgical risk is good and after efficient preoperative preparation an examination with the patient under anesthesia should be made and a specimen of tissue should be removed for examination. The extent of involvement should be noted at this time. If the lesion is operable I think it is highly advisable to proceed with the major operation at once as I feel that to cut into a malignant growth even to get a small specimen and then to delay the commencement of treatment for weeks or even several days reduces the prospect for cure.

In spite of attempts to educate the public and to train physicians the fact remains that most of the early lesions seen at the Clinic are those accidentally discovered during the course of a general examination.

In thinking of prophylactic treatment of first importance is the proper handling of patients who have chronic uterine infection whether the infection is limited to the cervix or has extended to the endometrium. The important consideration therefore is not only the treatment of the traumatic lesions of childhood but also the treatment of any cause of irritation such as infection or strictures that would prevent free drainage from the uterine cavity.

In treatment of carcinoma of the uterus only three methods are

considered, (1) surgical removal, (2) radiotherapy or (3) a combination of the two. Patients who have involvement of the body of the uterus and for whom the surgical risk is good are usually treated by total abdominal hysterectomy plus removal of the tubes and ovaries, it is only when the disease has spread to other organs or when there is enlargement of regional lymph nodes that a more radical procedure, followed by treatment with roentgen rays, is considered. The operative risk is no greater than that entailed in operation for benign conditions, it should not be more than 1 per cent at the greatest and the prospect for five year cures is about 68.7 per cent. It is just possible, and especially so in the case of Wertheim type of operation, to perform a grade 2 or grade 3.

be added to the operation. In the treatment of patients for whom the surgical risk is great and who have extensive involvement, intra-uterine use of radium, followed by three full courses of treatment with roentgen rays is advisable.

The treatment of epithelioma of the cervix is much more difficult than treatment of carcinoma of the body of the uterus. To begin with the patients, as a rule, are relatively young and still continue to menstruate, with resultant periodic increase in blood supply and active lymphatic drainage. At least 75 per cent of the lesions are epitheliomas of an active type (grade 3 or grade 4).

Before radium was used in the treatment of malignant conditions, when surgery was the only recognized type of treatment, and before recognition of the value of preoperative preparation of chemotherapy, of transfusions, of fluids introduced directly into the venous system and of all these things, the operation was almost always a failure. The very of the benefit of radium and roentgen rays, the medical profession, with few exceptions, was satisfied to advise radiotherapy in all cases of epithelioma of the cervix. It was not until a sufficient number of patients were treated and followed for at least five years that it was found that, while the local lesion was apparently eradicated, all but about 25 per cent of the patients died of carcinoma and many of those still living had urinary and fecal fistulas, roentgen ray burns of the skin, strictures in the ureters and bowels and damaged, painful bladders.

In recent years many gynecologists have advised a Wertheim type of hysterectomy, either preceded or followed by treatment with roentgen rays in all cases of carcinoma of the cervix. This procedure, which is of five years' standing, has been followed by a high percentage of cures. Complications have occurred. In advanced cases Taussig's procedure is used. This procedure consists of a complete dissection of lymph nodes

In recent years many gynecologists have advised a Wertheim type of hysterectomy, either preceded or followed by treatment with roentgen rays in all cases of carcinoma of the cervix. This procedure, which is of five years' standing, has been followed by a high percentage of cures. Complications have occurred. In advanced cases Taussig's procedure is used. This procedure consists of a complete dissection of lymph nodes

age than does carcinoma of the cervix and in more than two thirds of the cases it is a grade 1 or grade 2 lesion

SYMPTOMS

The early symptoms of uterine carcinoma are much the same, whether the growth is primary in the cervix or in the body of the uterus, and are uniformly listed in most papers on the subject as (1) irregular vaginal bleeding (2) foul watery discharge and (3) pain. Unfortunately these are the symptoms of a well advanced lesion in most cases, not the symptoms of a growth that is still operable. Any one sign, such as irregular spotting of blood between menstrual periods or after the menopause, indicates the need for examination of tissue by a competent pathologist. Unfortunately, during the course of a general examination or at the time of an operation, a well advanced malignant lesion frequently is found that had apparently given no symptoms which the patient's medical adviser had considered suggestive of a malignant growth. This is especially true of malignant growths of the uterine body, but cases are encountered occasionally in which the lesion is well inside the cervical canal and the vaginal part of the cervix is not involved.

TREATMENT

In any case in which carcinoma is suspected the important consideration is to get the patient under treatment as soon as possible. After a thorough medical check to determine whether the surgical risk is

delay the commencement of treatment for weeks or even several days reduces the prospect for cure.

In spite of attempts to educate the public and to train physicians, the fact remains that most of the early lesions seen at the Clinic are those accidentally discovered during the course of a general examination.

In thinking of prophylactic treatment, of first importance is the proper handling of patients who have chronic uterine infection, whether the infection is limited to the cervix or has extended to the endometrium. The important consideration therefore is not only the treatment of the traumatic lesions of childbirth but also the treatment of any cause of irritation, such as infection or strictures that would prevent free drainage from the uterine cavity.

In treatment of carcinoma of the uterus only three methods are

protruding from the cervix and more or less covering the local growth. Care must be taken to protect the vagina from any spill of zinc chloride as this chemical kills any tissue with which it comes in contact. The vagina is then packed with dry gauze.

The abdominal operation is proceeded with immediately. I prefer a midline incision of sufficient length to afford good exposure. If it is necessary to extend the incision up to the umbilicus I prefer to cut the umbilicus free from the fascia and keep it in the midline rather than to go to one side of the umbilicus in making the incision through the skin. In closing the wound I prefer to overlap the fascia in the upper part of the wound to protect against postoperative hernia.

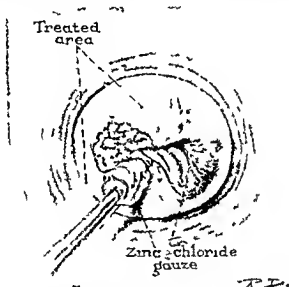


Fig. 276—Cauterizing local growth with saturated solution of zinc chloride.

The first step in the operation proper is to put a long Kocher hemostat on each side of the uterus. Next a hemostat is put on the right round ligament close to the internal abdominal ring and the ligament is cut and tied at that point. The right infundibulopelvic ligament is then cut between clamps at the brim of the pelvis and the proximal end tied with catgut. By blunt dissection the parametric tissues and those inside the broad ligament are stripped toward the uterus thereby exposing the ureter which is freed along its course from the brim of the pelvis to the point of insertion into the bladder. The ureter can then be held out of the way by a piece of tape carried around it. The uterine vessels are exposed and ligated close to the internal iliac vessels. A similar procedure is carried out on the left side.

as is advised in the Wertheim operation but without removal of the uterus, followed by administration of full doses of radium to the cervix and to the interior of the uterus and by administration of full courses of treatment with roentgen rays to the pelvis I have had practically no experience with this method but it sounds logical and is worth a thorough trial I believe that once regional lymph nodes become involved the outlook is hopeless in so far as the possibility of cure by radiotherapy alone is concerned, whereas by removal of the nodes much palliation and some cures will be effected

Many papers stress the notion that carcinoma of the cervix is a much more dangerous condition than carcinoma of the uterine body. It is not the location of the primary malignant growth but the degree of malignancy, as graded by Broders' method, that accounts in a large measure for the difference in results, as indicated in tables 3 and 4. In the groups in which lesions of grade 1 and grade 2 occurred, more than 70 per cent of patients remained free of symptoms for more than five years after operation, whereas in the groups in which growths of grades 3 and 4 occurred only 50 per cent of patients lived for five years, irrespective of where the growth originated. The better results in the whole series which followed operation for lesions that originated in the body of the uterus as compared to those which followed operations on the cervix, are explained by the fact that adenocarcinoma of the endometrium, as a rule, is much less malignant than the squamous cell lesion that occurs predominantly in the cervix.

Technic of Operation.—If Wertheim hysterectomy is to be performed in any case of uterine carcinoma I think the local care of the cervix and the vaginal canal is important. After the patient is anesthetized, and I prefer well given general anesthesia to spinal anesthesia, the vaginal canal should be thoroughly cleaned and sterilized with care taken not to make any abrasions where free malignant cells might lodge and later permit recurrent growths to start. Some attempt should be made to sterilize or destroy the outer surface of the local growth for this purpose I prefer painting it with a saturated solution of zinc chloride (fig 276) to partial removal or the use of a cautery both of which cause bleeding and leave a friable vascular surface.

f
the mucosa from the vaginal vault after insertion of a strip of zinc chloride gauze, wrung dry well up into the uterine cavity. If it appears that it is not possible to close the vaginal mucosa over the cervix as is often true in cases in which cauliflowerlike growths

not see any logical reason for removal of lymph nodes higher up unless the more proximal nodes are involved. I also make a point of saving enough peritoneum to permit a satisfactory closure and thereby limit as much as possible the amount of raw surface so that protection against adhesions and possible postoperative obstruction is obtained.

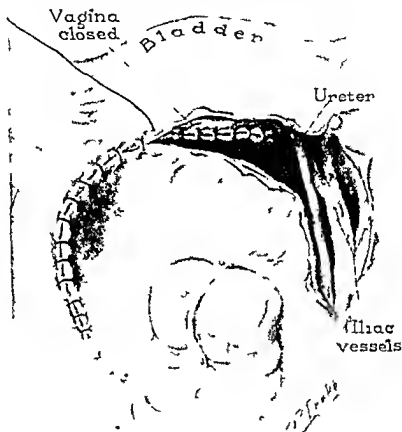


Fig. 978 Closure of vault of vagina and peritoneum

Two and a half grams of powdered sulfathiazole are then dusted into the pelvis and the wound closed in the usual manner. This operation should be completed in an hour to an hour and a half. There should be only a minimal amount of hemorrhage and comparatively little shock and pain.

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... about seventeen to eighteen days

the dissection being carried well down on the side of the vagina after free mobilization of the bladder and severance of the uterosacral ligaments well away from the uterus (fig 277)

I usually open the vagina posteriorly at about the junction of the upper and middle thirds and, after removal of the gauze that was inserted at the time of preparation of the vagina, I put in a fresh dry piece of gauze with 25 gm of sulfathiazole, then I complete the

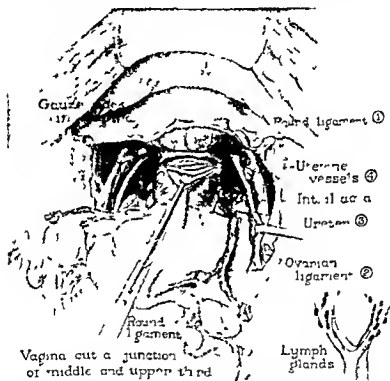


Fig 277—Dissection necessary to expose lymph nodes in the broad ligaments and upper third of vagina. Inset shows distribution of lymph nodes

RADIUM THERAPY OF CANCER OF THE UTERINE CERVIX AND OF THE FUNDUS

ROBERT E. FRISKE

It is remarkable that cancer developing in different parts of the same organ, in the cervix and in the fundus of the uterus, can present such dissimilar aspects. Consider cancer of the cervix. This malignant ————— menopause, it is roscopically and to nearby vital organs or by metastasis. Cancer of the uterine corpus, however, occurs usually at a later age, after the menopause. It grows more slowly, enveloped by the muscular walls of the uterus. Microscopically, it is generally a low-grade cancer. If untreated, widespread metastatic growths eventually develop and cause death.

Because of the early and rapid spread of cancer of the cervix, surgical treatment has not achieved outstanding results in the majority of instances. The insidious onset of the disease ordinarily precludes early diagnosis. Wertheim hysterectomy is the only type of surgical attack likely to cure, this very radical operation can succeed only in the few cases in which diagnosis is made early in the disease. The operation is technically difficult and involves a high mortality rate except in the most experienced hands.

The advent of radium therapy offered a new hope for sufferers from this widespread and rapidly growing form of cancer. Radium therapists seized this opportunity by development of careful technics and procedures. Here was an accessible lesion, visible and palpable, if radium could cure cancer, this particular growth offered a real challenge.

The successful technique of radium therapy worked out during the past three or four decades have been substantially aided by simultaneous progress in physics, surgical pathology, electrosurgery and research in the biologic effects of irradiation. Physicians in France, the birthplace of radium therapy, had an early start in cancer treatment. The work of Cheron and Rubens-Duval among others was materially assisted by Dominici, who introduced the method of heavy filtration of radium to secure gamma rays for efficient depth dose and to secure a homogeneous beam.⁴ However, American physicians soon followed suit. The first successful treatment of carcinoma of the cervix in this country by Robert Abbe of New York in 1906 was reported by T. Abbe of Washington.

In 1915, Kelly and Burnam of Baltimore reported their pioneer

after operation, and in all cases in which involvement of lymph nodes occurs, at least two additional courses are given about a month apart

SUMMARY

The cure of carcinoma of the uterus lies in early diagnosis and efficient treatment. The grade or type of malignancy is more important than the extent or location of the primary growth.

Three types of treatment are recognized: (1) surgical removal of the local growth plus removal of regional lymph nodes, (2) application of radium to the local growth plus administration of roentgen rays over the pelvis and (3) surgical removal plus radiotherapy. It is recommended that it be done by a gynecologist, if possible, and that if he is not experienced in radiotherapy, it should be given by men who specialize in such treatment.

Preoperative preparation, including care of the vagina and the local growth, careful thorough dissection of the regional lymph nodes, chemotherapy, modern anesthesia given by an expert and recognized modern postoperative treatment are all essential.

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- 3 Schmitz, Henry. The classification of uterine carcinoma for the study of the efficacy of radium therapy. *Am J Roentgenol* n.s. 7:383-395 (Aug) 1920
- 4 Vital statistics of the United States. U. S. Department of Commerce, Bureau of the Census. Part 1, 1942. 28 pp.

In this country, description of the anatomic extent or stage of the lesion is generally in accord with the outline submitted by the Radiological Sub Commission of the Cancer Commission of the League of Nations.²³ Four stages are defined. In stage 1, the cancer is limited entirely to the cervix. In stage 2, the lesion has extended into one or both fornices, with or without infiltration of the adjacent parametrium, the uterus is still freely movable. Stage 4 consists of massive infiltration of the parametrial tissues with fixation, the so called frozen pelvis or involvement of the bladder or rectum, or infiltration of the entire vaginal wall or the presence of remote metastatic growths. Stage 3 is an extensive involvement greater than shown in stage 2 but less than in stage 4. At the Clinic, 90 per cent of our patients are in stage 3 or 4 when referred for radium therapy.⁷

Treatment of Cancer of the Cervix.—Cancer of the cervix presents too complex a problem for the radiologist alone. The importance of early diagnosis cannot be overstressed. The family physician is the patient's first line of defense, he must be cognizant of the early signs and symptoms of cancer and must always bear them in mind. Once a malignant lesion is suspected the patient is best seen at one of the several hundred tumor clinics situated in this country. Following a thorough general and pelvic examination, the patient is seen by the surgeon and the radiologist and the best possible treatment for the individual case is outlined. Co operation of the clinician, pathologist, radiologist and surgeon is essential.

Radium Therapy.—Different plans of treatment are followed at various radium clinics depending on the experience of the staff and on the physical equipment of the clinic. In general, there are three main schools of thought. As Ewing described the general methods, they are (1) the prolonged single exposure to moderate doses of hard rays, (2) smaller fractional doses at varying intervals and (3) the single large dose at full exposure.

Details of irradiation technic have no place in this general study. A description of our own technic has been published before.⁸ Our plan

receives a total dose of 7000 to 8000 milligram hours throughout the entire birth canal in approximately eight applications in a period of

irradiation of the entire birth canal, by fairly short repeated treatments, (2) avoidance of trauma in probing the canal and inserting the tube, (3) use of the knee-chest position to secure adequate exposure and to avoid trauma during the necessary manipulations, (4) use of adequate

work in the treatment of cancer of the cervix with radium before the American Medical Association and the American Gynecological Society and gave the necessary impetus to the development of therapeutic radiology in this country. Radium therapy was started at the Clinic and many other centers in this country about 1915.

CARCINOMA OF THE CERVIX

The scope of the problem is shown by the high incidence of the disease. Annually about 13 000 women in this country die from this form of cancer. One of every 100 women registering at the Clinic comes for treatment of cancer of the uterus and at the Clinic cancer of the cervix outnumbers cancer of the fundus three to one.

If cancer of the cervix could be described in one word that word would be " "

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menopause about forty nine years this metrorrhagia seems unimportant to the patient she expects to menstruate irregularly at this time of life. Of course exceptions occur. Our youngest patient whose lesion was proved to be carcinoma of the cervix at the Clinic was a girl aged thirteen years and a case has been reported in which the patient was a child aged seven years.⁶ However these are rare exceptions. Women entering the menopause rarely consider that they may have a malignant growth malignancy is associated usually only with old age. They forget that functionally the uterus is old at the time of

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Stage and Grade—The prognosis of cancer of the uterine cervix

the cervix are squamous cell epitheliomas and of these about 85 per cent are grade 3 or 4 (Broders method) a rapidly growing type of

squamous cell epithelioma and grade 2 carcinomas to have as good a five year survival rate as grades 3 and 4. This is probably due to the individualized treatment which can be applied more effectively to the accessible and more visible cancer of the cervix than to cancers in other locations as in the fundus.^{8, 17}

Thus irradiation therapy at the Clinic is primarily radium treatment, with supplementary help from roentgen treatment. The radium tube in direct contact with malignant tissue is a flexible physical agent which produces necrosis of the cancer (figs 279 to 283, inclusive) and, as we have used it here, helps build up the defensive powers of the patient. The more rapid falling off of energy at a distance from the tube than is the case with roentgen rays protects the adjoining normal tissues, such as the urinary bladder and bowel. Normal tissues overlying the growth are not traversed by the gamma rays to reach the malignant lesion. It is quite true that radium can be used as a cauter, by use of less filtration and longer duration of individual treatments. We prefer



Fig 283—Phagocytosis, after radium treatment for carcinoma of the cervix showing taking of nuclear material of dead cancer cells ($\times 550$) (From Alter, N. M. Histological changes in squamous cell carcinoma of the cervix after radiation J. M. Research 40)

to employ the element for careful homogeneous effect on the cancer and to stimulate the resistance of the patient. Complicated pieces of apparatus are avoided, the simple radium tube can be adapted to any distortion of the parts. The efforts of some radiologists to eliminate the use of radium by employing vaginal cones and treating the primary growth by roentgen rays seems superfluous, except for those unacquainted with the proper use of radium. Correctly used, radium performs a miraculous job with the primary carcinoma, where we need additional help from roentgen treatment is in sterilization of the involved parametrial lymph nodes.

Since 1904 microscopic studies of radium treated cancers have been

gauze packing above the tube to increase the distance of the intestinal wall from the element, and (5) adequate follow-up studies of each patient over many years

Fig 279



Fig 280



Fig 281



Fig 282

Fig 279—Cancer of cervix before treatment

Fig 280—Normal reaction of carcinoma of the cervix to radium therapy, toward end of treatment

Fig 281—Clean vaginal vault, two years after radium treatment for cancer of the cervix

Fig 282—Clean vaginal vault, thirteen years after radium treatment for cancer of the cervix. All photographs shown were taken with patient in knee-chest position

a limited course, with no hope of cure but with hope of obtaining valuable palliation. If we are too optimistic, we may outline a full course and encounter complications which necessitate stopping the radium therapy and having to list the case as "abandoned." In a study⁸ of 1,337 traced patients 52.9 per cent of those receiving complete treatment lived three or more years after treatment compared with only 21.4 per cent of those whose treatment was limited, and 30.3 per cent of the smaller number in whom the treatment was abandoned. We must remember, however, that palliation gained by limited treatment is often invaluable and many patients who have massive cancers must not be refused a chance of help, even though the five year survival rate is greatly lowered by accepting these patients.

Complications Encountered During Treatment—During the first course of treatment, the main complications we have encountered in 5 or 6 per cent of our patients have been due to spread of infection or to hemorrhage. All cervical cancers are infected when first seen, the topical application of bactericidal agents during the course of treatment clears up the majority of localized infections. Of late years topical application of sulfonamide powders during treatment has appeared to cut down the spread of infection. Occasionally, however, pelvic cellulitis spreads, eventuating in a pelvic abscess or peritonitis. Cancer therapy is then stopped and measures are taken against the infection. The recent development of sulfonamide drugs and penicillin has undoubtedly cut down our treatment mortality rate even though in former years this has averaged only 1 per cent. Once the spread of infection has been halted and the patient's elevated temperature returns to normal, cancer therapy may be resumed, sometimes after a rest period of one or two weeks for the patient to regain her strength.

In treating hemorrhage associated with cervical carcinoma, tight packing of the vagina with gauze every other day while proceeding

complication. Some patients when first seen are so exsanguinated that transfusions and other supportive measures are necessary before cancer treatment can be started. Anemic tissues also heal more slowly than normal tissues.

Complications which appear during subsequent visits of the patient are usually due to spread of the malignant lesion uncontrolled by the previous radium therapy. They are usually due to lateral parametrial

made and reported." The histologic changes due to irradiation are unique and differ from those seen after any other form of therapy

by atomic energy (the gamma rays of radium) and by the softer roentgen rays is not entirely known. Ewing expressed the belief that the radium rays had a more direct necrotic effect on cancer cells and roentgen rays produced most of the reaction of connective tissue observed following treatment. Hence the two agents are supplementary. From clinical observation over many years I have felt that in carcinoma of the cervix, as in cancer of the rectum, the oral cavity and other accessible locations, radium is a superior agent if properly employed with roentgen therapy as a valuable adjuvant. Of course well planned roentgen therapy is superior to poorly devised radium treatment, my own opinion favors a careful blending of the two agents.

Results of Radium Therapy—In recent years much emphasis has been placed on five year survivals in cancer. Much less consideration

with no evidence of cancer provides us with a certain yardstick. A

cases in which the patient came to the Clinic after some treatment elsewhere were less satisfactory. This "modified" group formed a large portion—412 patients of the total of 1,491—in the study just mentioned. Five year arrest of the cancer in stages 1, 2, 3, and 4 was 100 per cent (only four cases), 56 per cent, 19.8 per cent and 4 per cent respectively, of the patients treated. The five year survival rate of all patients primary and modified, of all stages, was 26.8 per cent of the 1,352 patients traced.

The five year salvage of any radium clinic varies with the number of extensive cancers (stage 3 or 4) and the number of modified cases accepted for treatment and also with the number of "complete" treat

therapeutic success
course of treatment in the hope of curing the malignant lesion or only

followed by irradiation. If the lesion is inoperable and the fetus not yet viable, the growth should be treated by irradiation, abortion will of course occur.

Future Developments in the Treatment of Carcinoma of the Cervix.—Obviously, the good five year results obtained by radium treatment, by surgical treatment or by a combination of the two modes of attack in stage 1 and stage 2 lesions emphasize the importance of early diagnosis. The insidious character of the disease lessens the chances of early treatment. Everything possible for early detection of the growth should be attempted. Diagnosis by the vaginal smear¹⁰ should prove of value. The cancer prevention clinics have detected early cancers of the cervix, for instance, in Philadelphia among 1,000 women examined, three were found to have cancer of the cervix, although none of the 1,000 patients had had any symptoms or signs of a malignant lesion.³ In early carcinomas of the cervix, Wertheim hysterectomy plus irradiation, or radium therapy alone, offers a good prognosis. The mode of attack depends on the individual patient, her general physical condition and the skill and experience of the surgeon and the radiologist available.

Another hopeful development for a limited number of patients is Taussig's iliac lymphadenectomy, combined with radium therapy to the primary growth.¹¹ This operation avoids the risk of the Wertheim procedure. It consists of bilateral removal of the hypogastric, obturator, external iliac and ureteral lymph nodes. These lymph nodes are often involved and may not be entirely inactivated by roentgen therapy.

In a few cases, three or six months after the complete course of radium therapy, in lesions not beyond stage 2 in extent. The one criticism against the procedure beyond the added risk of any surgical measure, is that at best only 80 per cent of the lymph nodes are removed at this operation and activity may be present in nodes which remain. Further trial of the procedure seems justified in the small group of cases in which lymphadenectomy is feasible.

CANCER OF THE UTERINE FUNDUS

If any woman, doomed to have an internal malignant lesion, could select the organ to be involved, cancer of the uterine fundus would be a wise choice. Not as insidious a disease as carcinoma of the cervix, the lesion is of lower grade microscopically and grows more slowly, affording time for recognition and proper therapy. The heavy muscular wall of the uterus restrains the growth for a long time, however, once the fundal wall is perforated and the peritoneum reached the cancer grows most rapidly and distant metastatic growths usually cause death. In the

ureters are occluded, death from uremia ensues and is the most common cause of death in uncontrolled cervical cancer. When one kidney is functionless palliative radium therapy may delay the fatal outcome. Other late complications are rectovaginal and vesicovaginal fistulas. Occasionally, delayed healing of tissues following radium therapy results in the formation of craters at the site of the cervix, covered with

grams and blood urea determinations should be carried out. Limited radium therapy usually affords some palliation in the presence of these late complications.

Less Common Instances of Cancer of the Cervix.—Cancer of the stump of the cervix is occasionally encountered, following former subtotal hysterectomy. At the Clinic, we have followed the reasoning of Sharples and of Nuttal and Todd in accepting as true cancers of the cervical stump only those diagnosed at least two years after the subtotal hysterectomy, otherwise they are probably "coincident cases," dual carcinomas or metastatic lesions from fundal or ovarian cancers. With this limitation fifty-seven cases were found in a study of 1,676 cancers of the cervix at the Clinic constituting 3.4 per cent of the total cases.¹⁶ Radium therapy has to be modified, the deep portion of the

Another less common worry for the radiologist is the problem of carcinoma of the cervix associated with pregnancy. Among 3,570 cases of carcinoma of the cervix encountered at the Clinic in a period of thirty-two years Maimo and Mussey found coincident pregnancy in twenty-six (0.7 per cent). The prognosis appeared as favorable as in carcinoma of the cervix not associated with pregnancy. A five-year arrest of the cancer was obtained in 30 per cent of patients followed

Thus at the Clinic a review of early cases in which radium treatment was used from 1915 to 1928 inclusive showed that 78 per cent of the lesions were stage 3 or 4 and a five year survival rate of only 12.63 per cent was obtained by radium treatment.⁶ Meanwhile results of total abdominal hysterectomy with or without postoperative irradiation had been very good (close to 70 per cent five year survivals).^{7,8} In earlier years surgeons felt much doubt regarding the efficacy of irradiation in cancer of the uterine body. This was because we were usually dealing with an adenocarcinoma instead of squamous cell epithelioma supposedly more radioresistant and usually with a low grade lesion microscopically also believed radioresistant. Radiologists also were not anxious to treat these lesions as they were invisible and could be diagnosed only by curettage and the stage or extent could only be outlined by pelvic and general examinations with much less certainty than the more accessible carcinomas of the cervix.

Gradually however better results than expected with irradiation of carcinoma of the rectum (also adenocarcinoma and usually of low grade) and of obviously inoperable carcinoma of the uterine fundus gave encouragement for more extensive use of irradiation in cancer of the fundus. As the average age of patients who have cancer of the uterine body is about ten years greater than the age of those who have malignant lesions of the cervix more patients with fundal cancer were found to have coexistent degenerative diseases such as diabetes mellitus, obesity, hypertension or myocardial degeneration. Hence the surgeon did not have to assume the higher operative risks and the radiologist was allowed to treat many earlier lesions.

At the Clinic a later review of results in patients treated with radium from 1925 to 1935 inclusive showed 39 per cent five year survivals. In 40 per cent of the 109 cases the lesions were of stage 1 or 2 compared to only 21.5 per cent in the earlier series in which only a 12.63 per cent five year salvage had been obtained.¹⁶

Radium Treatment of Cancer of the Corpus—The underlying principle of treating this invisible and poorly defined cancer is as with cancer of the cervix homogeneous irradiation of the entire birth canal employing the intensive broken dose method. Following the diagnostic curettage two 50 millicurie radon tubes in tandem formation filtered with 0.5 mm of silver and enclosed in a 1 mm brass tube on a long copper wire are introduced to the depth of the uterine canal for a period of twenty four hours. With the patient in the knee chest position the applicator can be readily introduced with little trauma. The

radon tubes are placed in the vagina and elevating the perirectal tissues to a safe distance. About a week later a second treatment is given.

average instance, carcinoma of the fundus is a postmenopausal disease, the onset is usually about ten years after the menopause. As vaginal bleeding years after cessation of the menses is sufficiently

examination and inspection of the cervix do not disclose any abnormality of the cervix, dilatation and curettage are the next steps to determine the condition of the endometrium.

Stage and Grade.—Cancer of the uterine body being a hidden cancer, and because its boundaries are not as detectable on pelvic examination as in cancer of the uterine cervix, delineation of the stage or extent of the growth is less accurate than in the case of the cervix. At the Clinic we have tried to divide the lesions into four stages, as in cancer of the cervix.¹⁷ In stage 1 the lesion is limited to the uterine cavity within the level of the internal os and the uterus itself is movable and not enlarged. In stage 2 the uterus is still movable but is definitely enlarged, the growth infiltrating the fundal walls. In stage 3 definite infiltration of the parametrium on one or both sides with limited mobility of the uterus has occurred, or infiltration on one side with fixation of the uterus, or infiltration of a large part of the cervix with or without involvement of the vaginal walls, or in some cases isolated metastatic growths to pelvic lymph nodes with a small primary growth. In stage 4 the uterus is enlarged and fixed with remote metastatic growths in many cases of general carcinomatosis.

Biopsy of the endometrium in most of our cases showed at least 75 per cent of the lesions to be adenocarcinoma, around 11 per cent squamous cell epithelioma, and the remainder not diagnosed as to type of cell. Grades 1 and 2 predominated, being present in at least 56 per cent of the cases, grades 3 and 4 were present in only about 31 per cent.¹⁷ In 13 per cent of the cases the lesion was not graded or tissue was not obtained.

Treatment of Carcinoma of the Uterine Fundus.—Because of the nature of cancer of the body of the uterus, characterized by slow

coexisting serious illnesses

In the early days of radium therapy surgical treatment was always the main reliance for cure and inoperable lesions only were irradiated

invisible and not too accessible cancer have been surprisingly good. Of course the five year salvage depends on the percentage of stage 1 and stage 2 lesions referred for radium therapy. At the Clinic our five year survival rate mounted from 12.63 per cent to 39 per cent when we treated a greater percentage of less advanced lesions. Study of the microscopic grade of the lesions yielded an interesting prognostic factor. Wherever in carcinoma of the cervix in which the treatment can be individualized the survival rate remained essentially the same for the different microscopic grades treated in cancer of the uterine corpus in which therapy is rather standardized the grade was a very important prognostic factor. our five year survival rates varied from 79 per cent in grade 1 to 12 per cent in grade 4.¹⁷

While everyone appreciates the value of irradiation in extensive inoperable conditions or in early lesions in patients with other serious coexisting disease agreement on the best attack on operable lesions in good surgical risks has not been reached. Burman and Heyman have expressed the belief that irradiation alone yields as good results as the best surgical treatment. Other authorities such as Ward and Sackett, Kaplan and many others favor radium therapy followed in a few weeks by panhysterectomy and salpingo oophorectomy. Heyman¹⁸ also reported 78.5 per cent five year survivals with surgical treatment followed by radium and roentgen therapy.

COMMENT

This study of the treatment of carcinoma of the uterine cervix and corpus from a radiologists point of view merely reflects my personal opinions gained from experience with radium and roentgen therapy since 1920. Carcinoma of the uterine cervix is primarily a radiologic problem except in the few cases in which diagnosis is made early in this insidious disease. Cancer of the uterine corpus on the other hand is primarily a surgical condition for the patient in good general health; however irradiation can accomplish a great deal for patients in whom coexisting illness entails considerable risk with any surgical procedure.

Radiologists like surgeons have made notable advances in technique in the treatment of pelvic cancer. Radiologists and surgeons must co-

operate in the study and effort devoted to each individual case. Even patients who have extensive apparently hopeless cancer deserve our best efforts. The results will not ornament our list of five year survivals but the palliation which can be gained is just as valuable. The relief of pain, cessation of bleeding and foul discharge, improvement of general well being, even the occasional return to duty of a kidney that had been reported to be nonfunctioning or relief of hydronephrosis are tremendously worth while.

dem is used, this time in the midportion of the uterus, it is placed by introducing the applicator to the depth of the uterus, then withdrawing it about 3 cm and bending the wire where it emerges from the cervix. Again the two 50 millicurie radon tubes are left for twenty four hours. If the uterus is very large, three tandems may be employed, in different positions but with some overlapping, thus the interior of the uterine corpus receives from 4,800 to 7,200 millicurie hours in a period of three weeks. With two intra-uterine tandems, the more usual treatment, at 1 cm depth from the midline of the tubes the dosage varies from 5,200 gamma roentgens at one end of the applicator to between 12,000 and 24,000 gamma roentgens at the midpoint of the applicator, depending on the amount of overlapping. In addition to the intra-uterine treatments, a deep cervical canal treatment of 50 mg filtered with 1 mm of platinum is placed for fourteen hours, and two or three

given when the lesion appears to be small and cure seems possible. It is

high voltage roentgen treatment, 200 kv, 30 ma, 50 cm distance, large fields, 550 r per field for four to six fields around the pelvis, one field a day. The roentgen therapy may be repeated three months later in the more extensive cases.

In extensive lesions limited radium therapy designed for palliation only, consists of the use of only one tandem and perhaps vaginal applications to shrink the growth and reduce pressure.

Thus the treatment of cancer of the uterine corpus is more standard

of radium. Nolan and Arneson warmly advocate this method. The Y applicator of Schmutz and Schmutz, Friedman's hysterostat and Kaplan's silver ring all show promise of improving results. Fahler and Martin also employ multiple radium tubes.²¹ The uterus is not an extension into the mass of energy than are the complications encountered in treatment when the fundal walls are necrotic.

Results of Radium Therapy—Results of radium treatment in this

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grossly often becomes a source of infection after subtotal hysterectomy as a result of interference with its normal blood supply and also because of a possible cessation of its normal physiologic action. It is therefore not uncommon to have to remove a retained cervical stump because of its residual inflammatory character. For these reasons it becomes an increasingly difficult problem to determine what patients should be treated by subtotal hysterectomy as it is impossible always to determine whether or not a cervix will continue to be healthy. Regardless of the opposing views it would seem that the interests of the young married woman would be better served if the cervix were left in position if on direct inspection it appears normal. History of infection is not obtained and she has not borne children.

Subtotal hysterectomy is a safe procedure and I am sure that this is one definite reason why it is applied in some cases in which total abdominal hysterectomy would be the better operation. I refer principally to those instances in which considerable edema is encountered in the ovarian ligaments and broad ligaments during the course of hysterectomy for metritis and chronic pelvic inflammatory disease. In conditions of this type which are of long duration the infection which usually is streptococcal in type extends to the lymphatics of the broad ligaments and to the lymph nodes along the iliac vessels and occasionally to the inguinal regions. Unless the extent of the infection is estimated carefully subtotal hysterectomy may be followed by extensive cellulitis of the broad ligaments which involves all pelvic tissues. Under such circumstances total abdominal hysterectomy with removal of both adnexa is the safest procedure and gives the best assurance of complete restoration of health because all tissues that are infected are totally removed and lymphatic involvement subsides rapidly. I am sure that subtotal hysterectomy in this type of case is potentially a more dangerous practice and has been followed by more complications and deaths than total removal of the uterus and adnexa.

Besides the pathologic condition of the cervix one other factor makes total abdominal hysterectomy preferable particularly in treatment of parous women and that is mobility of the cervix. In most cases in which women have borne children considerable stretching and tearing of the pelvic fascia and muscles of the pelvic floor has occurred which does not manifest itself until sometime later in life. This may result in some prolapse and retrodisplacement. To maintain the cervix in normal and comfortable position after subtotal hysterectomy in these cases is difficult, time consuming and unnecessary. When subtotal hysterectomy is used in this type of case it may become necessary later to remove the cervical stump and perform vaginal plastic repair. Hence total hysterectomy surely is more definitely indicated because the broad ligaments can be shortened, the vaginal vault adequately supported and the normal length of the vagina maintained.

PANHISTERECTOMY AND SUBTOTAL HYSTERECTOMY: INDICATIONS AND TECHNIC

VIRGIL S. COUNSELLER

THE term "panhysterectomy" means complete removal of the uterus, including the cervix. The most common conditions which necessitate this operation are uterine fibroids concomitant with disease of the cervix, carcinoma of the uterine fundus, chronic pelvic inflammatory disease, ovarian malignant lesions and, sometimes, disseminated endometriosis.

UTERINE FIBROIDS

The indications for performing panhysterectomy in cases of uterine fibroids should not be set forth rigidly because opinion differs greatly among gynecologic surgeons as to whether the cervix should be removed with the uterus. Many surgeons perform total hysterectomy routinely when abdominal hysterectomy is indicated. At the Clinic panhysterectomy is carried out in about 85 per cent of cases in which it is necessary to perform abdominal hysterectomy and subtotal hysterectomy in the remaining 15 per cent. Those who undergo subtotal hysterectomy are nonparous patients who have a normal appearing cervix; those patients who possess a short vagina (especially a short anterior vaginal wall), and those patients who have a normal cervix which is normally mobile. Some gynecologists maintain that there is no such thing as a normal cervix, therefore they recommend panhysterectomy. On the other hand some surgeons use subtotal hysterectomy as a routine procedure when abdominal hysterectomy is indicated.

The crux of this argument is logically the pathologic condition of the cervix. In cases in which hysterectomy is contemplated the cervix should be inspected and palpated carefully. Cervical erosions and

With the use of the abdominal approach, the cervix is not seen and is not palpated.

pelvis of the kidney. Further use of the abdominal approach leads to be normal.

amount of fixation of the cervix by adenomatous tissue in the broad

of Masson. He advised that the cervix be cut across just above the uterine vessels, then, while the cervical stump is held anteriorly by a tenaculum, the rectum is separated from the posterior wall of the cervix. The

vagin

freed

adnexa have been removed

The most satisfactory operation for menometrorrhagia with disseminated endometriosis is subtotal hysterectomy and preservation of some ovarian tissue if the cervix is good and if at least one ovary is free from the disease. Unfortunately, in many cases both ovaries are involved with chocolate cysts and bilateral salpingo oophorectomy is necessitated. When patients who have had one or more children become sufficiently disabled by the disease to justify hysterectomy panhysterectomy is indicated more frequently than subtotal hysterectomy.

TECHNIC OF PANHYSTERECTOMY

The technic of panhysterectomy should be well understood because certain hazards are involved which do not exist when subtotal hysterectomy is performed. Three structures must be dealt with, these are the large intestine, bladder and ureters. In some instances extremely troublesome hemorrhage may occur. This can be avoided or lessened by certain maneuvers to be described.

The abdomen is opened by a low midline incision and the omentum and small intestines are held back by a warm moist gauze pack or rubber pack. All pelvic viscera are palpated and inspected carefully. The mobility of the uterus and adnexa should be noted. Fibroids may be pedunculated, interligamentous or degenerative. The adnexa, if adherent, are separated and elevated first. The broad ligament is exposed by cutting the round ligament about 1 inch (2.5 cm) from the uterus on each side. The peritoneum is incised anteriorly around the uterus. If the adnexa are to be removed the posterior surface of the broad ligament is incised and all the vessels of the ovarian ligament can then be isolated up to the bifurcation of the iliac vessels. The

the ureters can be inspected. Inspection of the ureters is extremely important, in cases of chronic pelvic inflammatory disease, endometriosis and especially in those in which the patient has previously undergone intrapelvic operation.

CARCINOMA OF THE FUNDUS AND ADNEXA

In dealing with malignant lesions of the fundus and adnexa total abdominal hysterectomy is the operation of choice when the lesion is operable. Carcinoma of the fundus often originates on the lateral walls of the uterus and extends into the cervical canal. It is nearly impossible to manipulate the uterus during hysterectomy without extruding some of the malignant cells into the cervical canal. If curettage has been used to prove the presence of fundal carcinoma malignant cells are most certainly present in the cervical canal as the result of this procedure alone. In fact malignant cells have been found in the vaginal discharges in cases of fundal cancer, which is an excellent reason for thorough cleansing of the vagina and closure of the external os before total hysterectomy is carried out. It must be remembered also that 10 per cent of fundal malignant lesions have already extended to the fallopian tubes and ovaries and they must be removed regardless of the patient's age. The survival rate for patients who undergo total hysterectomy for low grade malignant lesions of the fundus is among the lowest for patients who undergo operation for malignant lesions of the female genital tract. The rate for the more malignant lesions of the fundus is higher.

CARCINOMA OF THE OVARIES

Carcinoma of the ovaries is best treated by means of total abdominal

potentially involves the cervix. If the growths have extended to the pelvic peritoneum or omentum it is well to proceed with panhysterectomy

therapy to the cervical canal is given

ENDOMETRIOSIS AND ADENOMYOSIS

The indications for panhysterectomy and subtotal hysterectomy in

When the patient is a young nonparous woman subtotal hysterectomy

Each round ligament is then attached to the vagina just mesial to the tie on the cardinal ligament. The operation is now completed except for peritonealization. This is done with a running suture beginning at the stump of the right ovarian ligament and ending at the ovarian stump on the left. These ovarian pedicles are inverted so that other structures will not become attached to them.

TECHNIC OF SUBTOTAL HYSTERECTOMY

The technic of subtotal hysterectomy differs only in the method by which the cervix is preserved. The cervix is divided just above the point where the uterine vessels are clamped and divided. This point is just below the internal os. The remaining part of the cervix may be coned out or cauterized and then closed with interrupted chromic catgut sutures. The broad ligament is ligated together with the uterine vessels. They then are reattached to the cervix on each side. The round ligament is attached just mesial to it. Peritonealization is conducted the same as in panhysterectomy.

Should it be desirable to preserve the adnexa on one or both sides in either operative procedure, the ovarian ligament and fallopian tube are clamped and divided near the uterus as soon as the round ligament is severed. During peritonealization the adnexal stump is inverted and placed back near the bifurcation of the iliac vessels, so that the ovary and tube hang from the side wall of the pelvis and are not drawn downward to the vaginal vault or to the cervical stump.

The uterus and adnexa are now entirely free and the cervix re

broad ligament. If tension is maintained the vessels cannot bleed so profusely should they be torn open. The next step consists in gauze dissection. By this means the bladder is pushed downward and the attachment of the pubocervical fascia to the uterus is exposed. This step is most important to prevent injury to the bladder. Adipose tissue over the uterine vessels is now pushed laterally to expose more clearly the uterine artery and the fibrous tissues of the lowest part of the broad ligament and upper margin of the cardinal ligament (Mackenrodt). The cardinal ligament including the uterine vessels is clamped and divided on each side. The end of the clamp should be about 1.5 cm. above the vesical tissue. The incision into the pubocervical fascia is made across the anterior surface of the cervix from the forceps on one side to that on the other and the fascia is cut from the cervix. If the uterus is held taut this structure is easily defined. The uterosacral ligaments are now separated from the cervix preferably with scissors. These ligaments do not need to be cut.

EACH SIDE. The anterior and posterior parts of the vagina are now easily defined. It is my custom to incise the vagina posteriorly because this procedure is safe. The free edge of the cervix is grasped with forceps, gentle traction is applied and the cervix is cut loose from the vagina with curved scissors. An attempt should be made not to leave any of the vagina attached to the cervix. As the cervix is separated from the vagina the vagina is grasped with a tenaculum posteriorly then on each side directly at the level of the attachment of the cardinal ligament then directly anteriorly. Traction is maintained on these tenacula.

Reconstruction of the vaginal vault is the next procedure. The vagina is closed by a mattress suture in order to invert the cut edge into the vagina. Should there be any bleeding from the cut edge the blood then will go into the vagina and not into the pelvic cavity.

It is important to note the attachment of the left cardinal ligament to the previous fascia. Care should be taken to keep the vagina back away from this suture. A

ing degree of severity whereas the repair work would have been done almost as a matter of routine if the hysterectomy has been done by the vaginal route

8 The foregoing advantages result in lowered morbidity and mortality rates. The hospitalization required by a patient with simple vaginal hysterectomy without repair is approximately half that required by one who undergoes total abdominal hysterectomy in my experience

9 Certain "poor risk" patients who do not tolerate abdominal procedures well can safely undergo hysterectomy by the vaginal route. Obesity, age and cardiovascular disease even if present in a marked degree rarely contraindicate vaginal hysterectomy

10 Postoperative discomfort is minimal and patients who undergo vaginal hysterectomy after previous pelvic laparotomy are quick to notice the fact that there is less pain after vaginal hysterectomy than after laparotomy

INDICATIONS

Menorrhagia—Menorrhagia with anemia due to small fibroids or intrauterine polyps is probably the most common indication for vaginal hysterectomy at present. Menorrhagia due to ovarian dysfunction with anemia which is not amenable to curettage and medical measures is another common indication. Both these conditions were formerly treated frequently with curettage followed by the artificial production of the menopause by means of radium or roentgen therapy in women more than forty years of age. In younger women in whom it was desirable to preserve the reproductive function a small dose of radium (400 mg hr) was advised. Radium is effective in about 50 per cent of cases and is used occasionally when all other measures fail before

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occasionally most of these patients are advised to submit to vaginal hysterectomy because (1) it has been shown that radium is only about 90 per cent effective in stopping the bleeding and about 10 per cent of patients will later require hysterectomy in spite of radium. (2) radium is contraindicated if there has been a history of pelvic infection. (3) the patient may refuse radium treatment because the latter frequently associate it with the treatment of cancer or rightfully wish to avoid menopausal symptoms which follow its use. (4) vaginal hysterectomy permits the inspection of the adnexa and their removal if necessary but more often their preservation which is a reasonable desire of most women. (5) repair of a relaxed outlet or cautery or amputation of the cervix may be indicated and under these circumstances there is little if any added risk to vaginal hysterectomy. (6) it is still possible for malignant lesions to develop in later years in a

THE SELECTION OF PATIENTS AND A TECHNIC FOR VAGINAL HYSTERECTOMY

JOHN M. WALCH

IN selecting patients for vaginal hysterectomy it is well to keep in mind the advantages of this procedure over abdominal hysterectomy, which are

1 It is practically an extraperitoneal operation. For this reason there is little likelihood of trauma to the peritoneal surfaces both visceral and parietal, so that there is less chance of peritonitis or adhesions. "Gas pains" and ileus are observed more rarely.

2 The incidence of thrombophlebitis and pulmonary emboli is less probably because there is no trauma of the large pelvic veins.

3 Pulmonary complications such as atelectasis and pneumonia are found less frequently for there is no abdominal incision to splint the abdomen and thus to interfere with the excursion of the diaphragm.

4 The incidence of shock is less because there is minimal trauma and loss of blood and the duration of the operation is shorter.

5 The entire uterus is removed, thus obviating any hazard resulting from a preserved cervix.

6 Since there is no abdominal incision the incidence of postoperative hernia, infection of the wound or painful wound is minimal. The occasional case in which vaginal hernia develops in my experience has been one in which the patient was operated on for prolapse. I have never seen vaginal hernia develop as a late complication when there was no prolapse demonstrable at the time of the original operation. I am satisfied that the incidence of prolapse of the vault and cervix after abdominal subtotal hysterectomy is greater than the incidence of vaginal hernia following vaginal hysterectomy when both operations were carried out originally for uterine pathologic conditions other than prolapse. Of course if prolapse is present the end results even more definitely favor the vaginal method.

7 If correction of urinary incontinence, cystocele, rectocele and prolapse is contemplated along with hysterectomy, certainly by all odds the vaginal approach would seem most logical as the risk of vaginal hysterectomy and repair is a fraction of the risk of abdominal hysterectomy alone and infinitely less than that of a combined vaginal and abdominal operation in one or two stages. It has been my experience that frequently patients in need of repair work are advised to defer it if abdominal hysterectomy is done and as a consequence they put it off indefinitely until the condition often reaches an alarm

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CONTRAINDICATIONS

on is present in the body of the uterus
 hysterectomy is preferable to vaginal h
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 elvic Operations—Previous pelvic operations 1

uterus subjected to radium and roentgen therapy whereas with removal of the uterus two sites in which cancer is encountered frequently, namely, the uterine cervix and body, are eliminated and (7) paradoxically, the risk of vaginal hysterectomy has been less in recent years than the risk of a menopausal dose of radium.

Prolapse.—Prolapse of varying degrees is another common indication for vaginal hysterectomy and will be discussed later in another paragraph.

Dysmenorrhea.—Dysmenorrhea which requires hysterectomy for relief is a fairly common indication for the vaginal operation. When all conservative measures fail and the patient is no longer concerned over preservation of the reproductive organs, vaginal hysterectomy offers complete relief with a minimal risk.

Chronic Cervicitis.—Extensive chronic cervicitis occasionally is not amenable to conservative measures and even amputation in some cases will not completely eradicate the leukorrhea which is present. This is possibly due to the fact that severe cervicitis occasionally is accompanied by chronic metritis and parametritis with a boggy subinvolted type of uterus which requires hysterectomy for relief, this can be accomplished vaginally with less risk than abdominally.

It is my feeling that as a general principle vaginal hysterectomy should be reserved for uteri of such a size that they can be delivered

to morcellate a uterus
more chance of infec
and disseminating an

unrecognized malignant lesion, all of which probably outweigh the advantages of this method for extending the indications for vaginal hysterectomy. Approximately 1 per cent of fibroids large enough to require morcellation are sarcomatous and fairly commonly a small early epithelioma of the cervix or an adenocarcinoma of the body of the uterus is overlooked in spite of preliminary biopsy and curettage only to be recognized by the pathologist after its removal. Certainly this risk of malignancy alone is greater than the risk of total abdominal hysterectomy in cases in which uteri large enough to require morcellation are involved, and the advisable procedure is the abdominal route unless other factors present, such as poor general condition of the patient, outweigh this.

By careful preoperative bimanual examination, both with and without the patient being under anesthesia and evaluation of the size of

in relation to the amount of relaxation of the pelvic floor,
it is possible
virgin patients
n be delivered

without morcellation or episiotomy in multiparous patients with considerable relaxation a fair sized fibroid uterus can be delivered readily

a large cystocele. Even though one may obtain a suprapubic and laterally result by use of this procedure it is not uncommon to find that the patient continues to have a sense of pressure in the region of the vagina. Incontinence, the is likely due to the uterus in its new location. This operation to within 1 cm care satisfactorily of only a minimal degree of prolapse. The vaginal mucosa is re elevation of the uterus which results is secondary to the axis of the uterus which causes the cervix to be thrust forward so that it is supported by the perineum. The slight twist of the cardinal ligaments also serves to elevate the cervix slightly. When this procedure is used before the menopause, which is rarely advised, because the uterus is usually too large, vaginal sterilization should be carried out simultaneously.

Manchester Operation—This procedure with high amputation of the cervix and imbrication of the cardinal ligaments has a greater degree of usefulness than the interposition procedure. It will take care of moderate degrees of prolapse and is admirably suited to the patient who presents marked elongation of the cervix. In younger patients to whom it may be desirable to preserve the uterus it is more difficult to perform but simultaneous vaginal sterilization should be carried out. The wisdom of subsequent pregnancy and labor is doubtful and instances of such have been reported. In my experience the Manchester and the interposition operations have not been satisfactory in cases of degrees of prolapse.

Certain modifications of the interposition operation in which the fundus of the uterus is removed have been devised by (1) Richardson who advocates removal of the cervix and endometrium and the interposition of a remaining wedge of myometrium as in the Watkins Weir operation; by (2) Richardson who favors the composite operation which embodies partial hysterectomy and interposition of the remaining fundus; by (3) Chaffin who is enthusiastic over vaginal subtotal hysterectomy in which the cervical stump is interposed. These procedures in my experience have had a limited field of usefulness but none have been satisfactory in the hands of their originators.

I am satisfied that there is no single procedure for the treatment of this disorder adaptable or utilizable for all degrees of this disorder. The only procedure is hysterectomy. Most of these patients are well past the menopause and if there is to be any surgical procedure directed at the uterus it should be that of removal. Vaginal hysterectomy permits recognition and excision of any associated enterocele sac as well as the

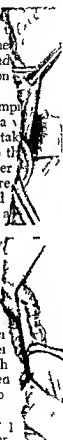


Diagram illustrating the Manchester operation, showing the removal of the cervix and the interposition of the remaining fundus of the uterus.

Mayo procedure with clamps or suture or the Kennedy clantion probably is not important as both have stood the test. In recent years I have preferred the ordinary or simple type of

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uterus subjected to the execution of vaginal hysterectomy. If ventral morcel of the uterus has been done previously as a rule the abdominal route, namely the fundus vaginally but occasionally this paradoxically, the fundus and one can do a Manchester operation recent years than elongated cervix. I recently removed an atrophic

Prolapse—Procedurally after ventral fixation which was 9 inches for vaginal. Usually other pelvic procedures such as internal salpingo-oophorectomy, do not interfere and vaginal

Dysmenorrhea is readily accomplished. Certainly one is "on guard" relief is afforded with the results of previous pelvic operations and all conservative considerations of vaginal hysterectomy are more heavily weighed over present circumstances.

offers comparison it can be well stated that all uteri are best removed

Chronic if the organ can be delivered without morcellation and if amenable to evidence of a malignant lesion or adnexal disease of a certain degree cases will

This is possible hysterectomy has become so safe a procedure in recent years that a mortality rate of 1 to 2 per cent for the total operation involuted uterus of us have forgotten that the vaginal route is even safer can be accepted with a mortality rate of 0.3 per cent and less for the same factors.

It is my opinion that the mortality rate from the abdominal operation should be reduced to lower the mortality rate from the vaginal procedure vaginally with reason I feel it is imperative for the gynecologic surgeon to remove it. If surgeon doing gynecologic surgery to be well versed in abdominal and the vaginal routes of performing hysterectomy

require morcelation and all patients are treated in the same manner early epithelial cases with increased risk or an inferior end of the uterus, each with both methods at his disposal he can weigh the only to be of each and choose that method best suited for the individual this risk of hysterectomy.

PROLAPSE OF THE UTERUS

cellation and for the correction of uterine prolapse are numerous and route unless only those used more commonly.

The patient Procedure—This and other methods of colpocleisis un- By careful had a field of usefulness in earlier days when the risk of out the vaginal procedure was unwarranted. I feel that its day of the uterus however is over as I have yet to see the patient who is one can perform risk that one of the more satisfactory procedures could to accomplish just as safely.

usually a Wertheim **Interposition Operation**—This has been without need for prolapse. It is most satisfactory in those patients with considerable prolapse or with elongation of the cervix a small uterus and

is pushed up laterally, thus pushing each ureter upward and laterally from the point at which the uterine vessels will be tied

In the presence of associated cystocele or urinary incontinence, the incision is extended along the anterior vaginal wall to within 1 cm of the external urethral orifice and redundant vaginal mucosa is re-

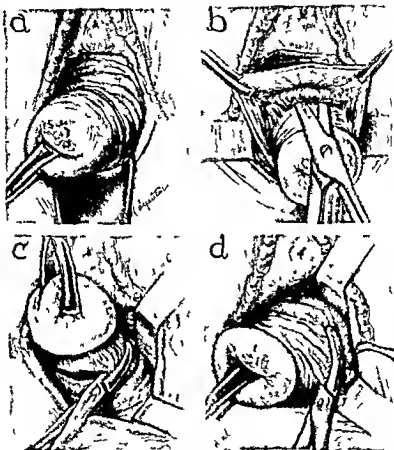


Fig 284—Vaginal hysterectomy *a* Circular incision at cervicovaginal juncture *b* dissection of vaginal flap from bladder and of bladder from uterus *c* opening into cul-de sac and clamp on left uterosacral and cardinal ligaments *d* clamp on uterine vessels Tie ligature on uterosacral and cardinal ligaments

moved After the pubocervical fascia has been separated from the vaginal flaps the two lateral parts of this fascia are brought together in the midline beneath the bladder and united with interrupted silk sutures Generally better exposure for repair of the cystocele can be obtained before removal of the uterus However in the presence of a

uterus subject to removal of the uterus frequently, namely, paradoxically, the which the broad ligaments are joined to serve as a recent years than the bladder. The incidence of postoperative vaginal

Prolapse.—Prolapse is definitely less thus far. Prolapse of the vagina with complete procidentia and large associated enterocele can be treated by the method described in the preceding paragraph. It is advisable to combine subtotal vaginectomy with the levatorplasty and suture the levator muscles to the joined broad ligaments. Thus producing a very strong and firm musculofascial diaphragm across the lower part of the pelvis, such a result is not possible if the levator is preserved. When large fibroids or ovarian cysts are present, their removal is advised. When large fibroids or ovarian cysts are present, their removal is advised. When large fibroids or ovarian cysts are present, their removal is advised.

Chronic cases.—Chronic cases of vaginal prolapse are treated by the method described in the preceding paragraph. It is advisable to combine subtotal vaginectomy with the levatorplasty and suture the levator muscles to the joined broad ligaments.

This is important whether the hysterectomy is carried out vaginally or abdominally. It is important whether the hysterectomy is carried out vaginally or abdominally. It is important whether the hysterectomy is carried out vaginally or abdominally.

It is my opinion that if a large enterocele is present the patient should be informed of the possibility of some shortening and if it is possible to preserve approximately normal depth the abdominal approach is preferred. Total hysterectomy with vaginal repair should be used when the risk is considerably greater than the benefit. The risk is considerably greater than the benefit.

TECHNIC

The technique described herein is quite similar to that used for total hysterectomy by Masson at the Clinic. I have been unable to find a description of the technique used by Masson at the Clinic.

This risk often and support of the vaginal vault by the round, cardinal ligaments, good depth and support are given to the vaginal vault which is closed by suture and which usually heals by primary intention rather than by granulation.

Most women prefer general anesthesia although spinal anesthesia is also used. A circular incision is made at the cervicovaginal junction. If there is sufficient prolapse to necessitate removal of more of the vaginal vault (fig. 284 a) the bladder is freed from the uterus and one or two short distances from the anterior vaginal flap this permits safe dissection without causing jeopardy to the bladder (fig. 284 b). Then usually traction is made on the cervix in the direction of the vaginal vault as elevation of vaginal flaps is secured by pushing them back against the gauze-covered finger. Likewise the bladder is elevated and

(fig 284 c), then this is cut and immediately secured with a ligature of chromic catgut no 1 placed with a needle. One end of the ligature is left long to facilitate closure of the peritoneum and reconstruction of the vault. The uterine vessels are included in the second clamp which is placed higher than the first (fig 284 d). The third clamp is used to control the utero ovarian anastomotic vessels which run alongside the uterus. Both are secured by use of suture ligatures.

The next step is to deal with the right side of the uterus in a manner similar to that on the left. Then the peritoneum is incised anteriorly along the line of vesical reflection (fig 285 a). This frees the uterus except for the horns. The fundus is delivered posteriorly, the round ligament, uterine end of the tube and utero ovarian ligament are clamped, cut and ligated on either side (fig 285 b). After inspection

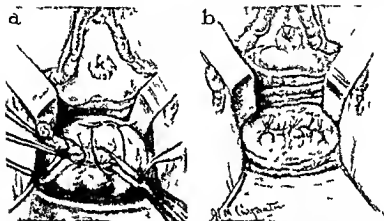
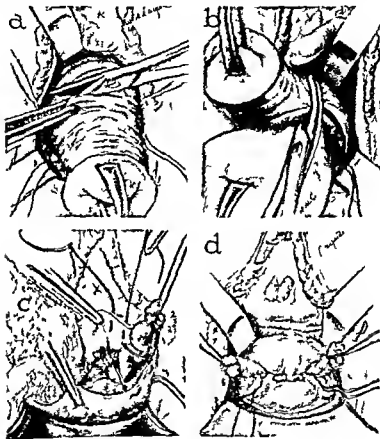


Fig 286—Vaginal hysterectomy (concluded) a Angle suture tied and approximated to uterosacral and cardinal ligaments. Next most medial suture placed through vault and left round ligament. b completed closure of the vault.

the adnexa are removed if indicated. By gentle traction on the ends of all eight ligatures the peritoneum can be brought into view so that it may be closed under direct vision. A running suture is used to approximate the vesical reflection of peritoneum and the posterior reflection in the cul de sac (fig 285 c). In this way all raw surfaces are placed extraperitoneally (fig 285 d).

Reconstruction of the vault and its support by closure of the incision in the transverse axis is now carried out. The suture most laterally situated in either angle of the vault is tied to the ligatures which were previously left long on the cardinal and uterosacral ligaments. The angles are thus approximated to their normal supporting structures. The corresponding round ligament on each side of the vault is included in the next two more medial sutures (fig 286 a).

large uterus that is likely to tear out some of the sutures as it is delivered repair of the cystocele had best be delayed until after removal of the uterus



peritoneum

After the cul de sac of Douglas has been opened the posterior surface of the uterus and peritoneum is explored with the finger to see whether there is any adherent intestine. A curved forceps preferably of the Heaney type is used to clamp the lower portion of the left broad ligament including the uterosacral and cardinal ligaments

SURGICAL TREATMENT OF ACUTE GYNECOLOGIC CONDITIONS

JOSEPH HYDE PRATT

ACUTE gynecologic conditions for which surgical treatment is necessary fall rather naturally into three general classes—congenital lesions, abdominal emergencies, and vaginal emergencies. Any discussion of the surgical treatment of these conditions involves discussion of the recognition and differential diagnosis of the lesion as well as of methods of handling the tissues and the adjoining structures. The knowledge a surgeon has of the situation which confronts him, as well as his recognition of the more common dangers of surgical treatment and in the prevention of postoperative complications and in minim-

been treated surgically in the last two years at the Clinic. In 727 cases an operation was performed by the emergency service during 1945 and 1946; of these cases 117 (16.1 per cent) were gynecologic. In fifty-five cases there were vaginal symptoms requiring dilatation and curettage alone. The fifty-five cases included forty-three cases (86.8 per cent) of incomplete abortion and twelve others (10.2 per cent). In eighteen cases (15.4 per cent) ectopic pregnancies were operated on in this period without a death. In two of these cases the diagnosis was established and operation was performed before rupture occurred. Bleeding from a graafian follicle or a corpus luteum was the reason for seventeen (14.5 per cent) operations, while seven (6.0 per cent) patients had acute torsion of an ovary or tube. The remaining twenty (17.1 per cent) comprised ruptured endometrial cysts, pelvic abscesses, acute salpingitis, ruptured uterus, and so forth.

Again it must be mentioned that a complete history, as well as a general examination, should be done. The onset of the menses, their regularity, the date and the duration of the last period, whether there is intermenstrual pain or bleeding, and whether there is progressive dysmenorrhea, give very definite indications whether a congenital lesion is present, whether there is a possibility of mittelschmerz, or ectopic pregnancy, or whether there is any likelihood of endometriosis. As Carrington pointed out in a discussion of the errors of diagnosis in 1932, emergency cases in which the patients were females, the cause of error was usually in overlooking some detail of the examination or of the history, and not in the ability or lack of ability of the examining physician.

Then the round ligaments are tied together in the midline and the vault is closed over the stumps so that they lie between the peritoneum above and the closed vagina below (fig 288 *b*). When a cystocele has been repaired also the tennis racket incision after closure assumes the appearance of an inverted T. Repair of the perineum if indicated is carried out last. A retention catheter is used only in the event a cystocele has been repaired. When repair work is not done the patient is able to be up in three days and can usually leave the hospital on the sixth day. When repair work has been done the patient sits up in eight days and leaves the hospital on the fourteenth day unless longer hospitalization is required because of residual urine.

SUMMARY

In selecting the operation for patients which require hysterectomy or correction of prolapse it is well to remember that the vaginal route offers certain distinct advantages and that vaginal hysterectomy is decidedly the most adaptable and utilizable operation for prolapse.

SURGICAL TREATMENT OF ACUTE GYNECOLOGIC CONDITIONS

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It is of interest in discussing the occurrence of some of these lesions to show the figures of the acute gynecologic conditions that have been treated surgically in the last two years at the Clinic. In 727 cases an operation was performed by the emergency service during 1945 and 1946, of these cases 117 (16.1 per cent) were gynecologic. In fifty-five cases there were vaginal symptoms requiring dilatation and curettage alone. The fifty-five cases included forty-three cases (36.8 per cent) of incomplete abortion and twelve others (10.2 per cent). In eighteen cases (15.4 per cent) ectopic pregnancies were operated on in this period without a death. In two of these cases the diagnosis was established and operation was performed before rupture occurred. Bleeding from a graafian follicle or a corpus luteum was the reason for seventeen (14.5 per cent) operations while seven (6.0 per cent) patients had acute torsion of an ovary or tube. The remaining twenty (17.1 per cent) comprised ruptured endometrial cysts, pelvic abscesses, acute salpingitis, ruptured uterus and so forth.

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SUMMARY

In selecting the operation for patients which require hysterectomy or correction of prolapse it is well to remember that the vaginal route offers certain distinct advantages and that vaginal hysterectomy is decidedly the most adaptable and utilizable operation for prolapse.

ABDOMINAL EMERGENCIES

Ectopic Pregnancy—The abdominal emergencies are the most serious of the acute gynecologic emergencies. Although in some cases vaginal bleeding can rapidly exsanguinate the patient the diagnosis of this condition is not as difficult as that of abdominal emergencies and treatment is usually instituted sooner. Ectopic pregnancy is outstanding of all the abdominal conditions and should be considered first. This situation occurs about once in 300 normal pregnancies.¹⁰ In 70 per cent of ectopic pregnancies the patients are multiparous while in 30 per cent they are primiparous. Also a patient who has had one ectopic pregnancy is more likely than the average woman to have a second ectopic pregnancy, since the condition of the two tubes may well be similar. The mortality rate has been brought considerably lower since the 1920's. This is entirely due to better preoperative and postoperative supportive treatment. In discussing a paper Miller reported that in Hartford, Connecticut from 1909 to 1928 there were 565 ectopic pregnancies in 62,913 live births. In this series of ectopic pregnancies there were twenty-three deaths, a mortality rate of 4.8 per cent. From 1928 to 1944 with better preoperative and postoperative care and transfusions there have been eight deaths in 357 ectopic pregnancies or 2.4 per cent. The number of live births was 69,704. In Philadelphia¹² from 1931 to 1943 there were 2,204 ectopic pregnancies with 101 deaths, an average of 4.6 per cent but during the last two years the mortality rate has been only 2.2 per cent. In a study of these 101 deaths it was evident that errors in diagnosis with delayed surgical intervention to the extent that thirty-six patients were not even operated on were the chief causes of death. Of the sixty-five patients on whom operation was performed, thirty-five were in shock and twenty-six died of hemorrhage. Of the twenty-one patients listed as good risks but who succumbed five were listed as having died from hemorrhage and ten from peritonitis. Five of the patients who died from peritonitis had undergone appendectomy at the time of operation for ectopic pregnancy. The other deaths fell into miscellaneous classifications. Delay in diagnosis, insufficient attention to preoperative and postoperative care and inadequate transfusions were the chief factors in the failures.

Generally the patient is seen in mild shock and is pale and perspiring with a distended, extremely tender abdomen and with marked rebound tenderness. The temperature is low or subnormal, the pulse rapid and weak and the blood pressure low. The leukocyte count will be elevated after a number of hours as a result of the blood in the peritoneum but is not indicative of the amount of bleeding. Restlessness, particularly air hunger and dyspnea, is the most reliable sign as to the seriousness of the loss of blood. Pelvic examination may reveal a tender, bulging mass in the cul de sac of Douglas and possibly

Appendicitis, though entering the differential diagnosis in almost all acute gynecologic conditions, will not be considered per se in this paper. Nor will certain other conditions, such as perforated diverticula, ureteral colic or a perforated viscus, be considered.

CONGENITAL LESIONS

The congenital lesions that fall into the realm of acute surgical conditions are those that are associated with malformations of the reproductive organs and that are brought to the attention of the examining physician at the time of the onset of the menses or shortly thereafter. The history is generally that of a girl in her teens who has never menstruated but has for some time had pains at monthly intervals that are often incapacitating. During one of these attacks the patient is brought to a physician. Examination will reveal a tender, bulging intact hymen with a dilated vagina and enlarged uterus or a normal vagina with a cervix that shows no evidence of bleeding from the external os. Rectal examination will give confirmatory information of a large, tender pelvic tumor that seems directly connected to the cervix. The diagnosis is hematocolpos in the first instance and hematometra in the second. In either case the surgeon must furnish an outlet for the menstrual blood and preserve as normal a genital tract as possible. These patients are rarely seen before several painful episodes have been endured and the vagina, uterus or both are therefore considerably dilated. In such situations the dilated organs have minimal resistance to infection while the residual blood that is not evacuated furnishes an excellent medium for bacterial growth. Rigid asepsis is therefore of utmost importance. The surgical treatment consists of incision of the hymen or dilatation of the cervix, as the case may be, with as little trauma to the tissues as possible. The blood is then evacuated from the genital tract.

At the onset of the menses, and a soft tender mass bulging along the side of the vagina

associated with this lesion may not require treatment. If there is a double uterus with one side functioning normally and the second with no external opening partial hysterectomy of the malformed segment is necessary. All of these patients have a fair possibility of pregnancy.

without as much pain on gentle manipulation of the cervix as is encountered in ectopic pregnancy. The suggestive signs of pregnancy are lacking and the menstrual history is normal. Also there is no evidence in blood counts or physical examination of any severe loss of blood. Rupture of a follicular cyst or graafian follicle will be considered later. Acute appendicitis is confusing only when the appendix is situated in the pelvis. Even so the history of abdominal pain, then localized pain followed by nausea and vomiting, points to appendicitis. The menses are normal and there is no relation of the attack to the periods. The physical signs of the abdominal examination are often localized to a very small area in the right lower quadrant of the abdomen. The temperature is elevated to 99.4° or 101° F and the leukocyte count is elevated. In appendicitis there are no signs of sudden, severe shock and no evidence of bleeding.

Acute pelvic inflammatory disease may be confused with tubal abortion with slow bleeding but not with the sudden typical tubal rupture and hemorrhage. Acute pelvic inflammatory disease customarily follows the menses or some pelvic insult and may cause vaginal bleeding. However, the temperature and leukocyte count are elevated, the sedimentation rate is increased, the tenderness is most often bilateral. Bilateral masses may be palpable and there may be evidence of infection in the vagina or cervix. Finally, the Friedman reaction is negative.

When the diagnosis of ectopic pregnancy has been made, the only treatment is operative. The incision is immaterial. Either a right or left rectus incision over the ectopic gestation or a midline incision can be used. When the abdomen is opened, salpingectomy can be done, pro-
tu-
be

as bilateral ectopic pregnancies have occurred.² All the blood clots should be sponged out of the pelvis to lessen the opportunity for infection to develop or for adhesions to form. If the bleeding has been minimal, there is no objection to performing appendectomy at the same time but, if the bleeding has been severe, it is safer to leave the appendix alone.

When the patient is in shock on admission the characteristic physical and pelvic examination and the history leave no doubt as to the diagnosis and the patient should be treated for shock while the operating room is being prepared. Intravenous administration of isotonic

to get a large enough needle into a vein so that blood can be given

a mass in one adnexa but it will definitely show exquisite pain on any motion of the cervix. Suggestive signs of pregnancy should be looked

The pain is continuous and if there is any blood beneath the diaphragm there may be referred pain to the shoulder. The last menses may be absent or possibly delayed and most often are scanty but the spotting may continue for days after a normal period would have ended. A history of intercourse is seldom difficult to obtain, though if the patient is a young unmarried woman, it is often necessary to explain the seriousness of the situation and to obtain her confidence before she will admit the possibility of pregnancy.

In cases of tubal abortion when the products of gestation are passing out of the fimbriated end of the tube, the bleeding and shock may not be quite so catastrophic. With the tissue in the fimbriated end, the bleeding may cease or be minimal for a period of hours or

worth while to wait for confirmative reports from a Friedman test. If the symptoms and tenderness continue even in the face of a negative Friedman reaction, posterior colpotomy can be done easily. The presence of free blood in the cul de sac of Douglas is sufficient evidence to warrant exploration.

The optimal time, of course, for treatment of any ectopic pregnancy is before the tube ruptures and real bleeding occurs. In this stage diagnosis is rarely accomplished and it is a therapeutic triumph when the correct diagnosis is made and exploration is carried out early. Again the history of abnormal or prolonged scanty menstrual period, plus a possibility of pregnancy, must make the examining physician

considered, such as torsion of an ovarian cyst. In the latter condition the onset may be as sudden and the pain as continuous as in cases of ectopic pregnancy. However, pelvic examination should reveal the cyst or at least limit the tenderness rather definitely to one side.

fact is extremely helpful in diagnosis. Nausea and vomiting are frequent. There is no history or sign of pelvic infection and there is no irregularity of the menses to suggest an ectopic pregnancy. Temperature, leukocyte count and sedimentation rates are all low and there is no decrease of the concentration of erythrocytes. Roentgenographic examination is often helpful either by direct visualization of a pelvic mass or by demonstration of an abnormal calcification in the pelvis.

Examination will reveal a tender lower abdominal wall, often with considerable rigidity present. The majority of the tumors that twist on their pedicles are large and easily palpable. Kelberg and Randall

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the bladder empty and the patient in moderate Trendelenburg position. Since these cysts must have pedicles before torsion can take place they can usually be easily delivered and the pedicle divided between clamps. The tube is often removed with the cyst even if it is not involved in the torsion. The remaining ovary must be inspected as some ovarian tumors are bilateral and there may be a tumor present in the second ovary. These patients have no loss of blood and speed is not as essential as in the case of an ectopic pregnancy. Therefore they reach the operating room in reasonably good condition and for this reason further surgical procedures can be carried out as seems indicated in the form of either hysterectomy or appendectomy or both. These patients stand surgical treatment well and postoperative complications are minimal.

A Twisted Fallopian Tube—This is one of the rarer lesions encountered. The symptoms are similar to those of torsion of a cyst but the physical findings are not as definite as when an ovarian tumor is encountered. The tube is usually adherent at the distal end and the twist is about its longitudinal axis. Surgical treatment consists in excision of the affected tube with preservation of ovarian tissue if it is feasible. Since this condition occurs primarily after adhesions from pelvic inflammatory disease it is often necessary to go ahead with additional pelvic surgical procedures to prevent future trouble for the patient.

Mittelschmerz—"Mittelschmerz" is the name applied to ruptured follicular cysts causing pain at the time of ovulation approximately twelve to fourteen days after the onset of the last menses. The name is also used indiscriminately for ruptured corpus luteum cysts occurring a few days later. It is synonymous with oophorrrhagia. While the symptoms were first described a hundred years ago it was not until the early 1930s that the first 100 cases had been reported in the literature. The condition is characteristic of young unmarried women, 70 to 80 per cent of the patients being less than twenty-five years old.³

rapidly If the patient is a multipara or gives a history of transfusions

normal as this will only provoke further hemorrhage but enough fluids should be given preoperatively to keep the systolic blood pressure between 80 and 100 mm of mercury The abdomen is opened through the midline for when a patient is in shock with 1 to 2 quarts (1 to 2 liters) of blood in the abdomen it is virtually impossible to be certain which tube is involved As soon as the abdominal cavity is opened a hand is passed into the pelvis which will be found to be filled with clotted and fresh blood The uterus is identified the tubes are quickly palpated and the one containing the pregnancy is tightly clamped between the fingers The bleeding is then under control and the blood clots can be evacuated The pelvis is cleaned the intestines are packed off and salpingectomy is done As soon as the vessels to the tube are clamped and the bleeding is controlled transfusions are of the greatest benefit as they now can be used to build up the blood pressure and circulating volume without danger of further hemorrhage All the blood clots should be removed from the abdominal cavity The appendix is not disturbed and the incision is closed in layers If blood for transfusions is not obtainable autotransfusion of filtered blood from the abdominal cavity can be used If compatible blood is on hand sufficient blood to bring the estimated blood loss to less than 1 liter should be given In the long run the ease of convalescence and the lessened morbidity more than compensate for the slight hazard of transfusion reaction from the additional transfusions

Regardless of how bad the condition of these patients seems when they are first seen accurate diagnosis with early surgical intervention and early restoration of the circulating blood volume will save practically all of them

Torsion of an Ovarian Cyst—Torsion of an ovarian cyst is a surgical emergency although a large percentage of the patients either have known of the presence of the adnexal tumor or will give a history of chronic pain or of similar attacks that have occurred over

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As much of the ovarian tissue as possible should be preserved. An atraumatic suture or two should be enough to control the bleeding. If not, then removal of the lining of the cyst and closure by a continuous locked suture will control the hemorrhage. The ovary should not be removed for there is no prognosis as to when the second ovary might be affected, perhaps even more severely. Both tubes should be inspected for possible ectopic pregnancies, as several unruptured ones have been reported associated with a ruptured corpus luteum. After the blood has been removed from the pelvis there is no contraindication to appendectomy.

The prognosis as to future attacks should be guarded as many of these girls have similar recurrent attacks after operation.

Pelvic Inflammatory Disease.—Acute salpingitis is now a medical disease in its early stages and should be treated by chemotherapy, rest, adequate fluids and diet and pelvic heat. In many cases the inflammation will subside spontaneously and never will need the attention of a surgeon. In some cases drainage of an abscess is required and in a few cases persistence of symptoms will necessitate a radical pelvic operation. It is primarily in the cases of early salpingitis, when the diagnosis is in doubt between acute salpingitis and appendicitis or mittelschmerz, that pelvic inflammatory disease enters the field of the acute surgical emergency.

Pelvic inflammatory disease starts characteristically after some provocation or pelvic insult such as childbirth, menses, alcoholic or sexual excess or abortion. The pain is bilateral and low in the pelvis with minimal abdominal spasm. The temperature is elevated often to 102° to 104° F with a marked elevation of leukocyte count and sedimentation rate. There may well be evidence of acute infection in the glands about the introitus in the vagina or in the cervix. Smears and cultures should be taken the latter on chocolate blood agar to determine whether a neisserian infection is present. On pelvic examination there will be marked tenderness on motion of the cervix with bilateral adnexal tenderness or masses.

If the differential diagnosis of appendicitis cannot be satisfactorily made exploration should be carried out at once. If acute salpingitis, even with purulent material dripping from the ends of the tubes, is encountered it should be left alone. Ten grams of sulfathiazole in the pelvis plus postoperative chemotherapy, should resolve the infection with a good chance of preservation of the function of the tubes. Appendectomy is not inadvisable. If the infection turns out to be a flare up of an old hydrosalpinx with sealed and obviously useless tubes bilateral salpingectomy should be done.

Ruptured Endometrial Cysts.—Ruptured endometrial cysts are occasionally encountered as emergency cases. The onset is sudden and may or may not be related to physical activity or trauma. The pain

It is due to the rupture of a graafian follicle cyst at the time of ovulation with the spilling of a small amount of blood into the peritoneal cavity, causing the symptoms. It is encountered also in the third week of the menstrual cycle after a corpus luteum has formed. When one of the latter ruptures, the bleeding may be more severe. The amount of blood lost is ordinarily small but occasionally death has resulted from hemorrhage.

No figures are available on the incidence, though McSweeney and Wood stated that there is one case of operation for ruptured cyst for every thirteen appendectomies. Other extensive reports of emergency surgery hardly mention the lesion. Certainly it is a common condition when looked for and in more than 50 per cent of the cases in which operation has been performed there was a past history of similar attacks. They may occur at monthly intervals, they may alternate sides and they may cease spontaneously. In the great majority the menstrual cycle is normal. The pain is low in the pelvis and most often unilateral. The onset is sudden with maximal pain present from the beginning. The temperature is little, if any, elevated. The leukocyte count is usually less than 12 000 per cubic millimeter of blood, rarely as high as 20 000. Nausea and vomiting are present in about a third of the cases.

These patients uniformly undergo operation under the diagnosis of appendicitis or ectopic pregnancy. Mittelschmerz differs from appendicitis in being a low abdominal pain, sudden in onset, with maximal pain from the beginning and minimal, if any, temperature reaction. On examination the tenderness is not marked and there is seldom real spasm or rigidity of the muscles. Pelvic examination may reveal localized tenderness in one of the adnexa. Mittelschmerz differs from ectopic pregnancy in the normality of the menstrual history, its characteristic midcycle occurrence, the lack of suggestive signs of pregnancy and the negative Friedman reaction.

If the diagnosis of mittelschmerz is made, the treatment is conservative. The patient should, however, be kept under observation as occasionally the bleeding is severe. The clinical course becomes progressively better within a few hours to a day or two while the leukocyte count begins to fall toward normal shortly after its initial rise.

When the diagnosis is in doubt between mittelschmerz and appendicitis it is best to carry out an exploratory laparotomy. If the symptoms are severe enough or if there are signs of considerable hemorrhage which would of course, suggest an ectopic pregnancy the patient should be advised to undergo an operation at once. Exploration in the case of a dubious diagnosis is best carried out through a midline or paramedian incision so that the entire pelvis can be inspected. The bleeding follicle or corpus luteum cyst can be identified easily and the treatment of choice is conservative surgery.

no evidence of hemorrhage or shock. The onset is not as typically acute as in a case of twisted cyst and although a tender pelvic tumor is present the abdominal wall does not resist the examining hand with the rigidity caused by torsion of a pedicle. Treatment is exploration and either myomectomy or hysterectomy. If myomectomy is done all the fibroids present should be removed at this operation.

VAGINAL EMERGENCIES

Vaginal emergencies do not cause the diagnostic difficulties that are occasioned by the intra abdominal ones. The presenting symptom is either hemorrhage or tumor. Cervical or endometrial polyps or pedunculated fibroids may twist on their pedicles or become infarcted from pressure as they pass through the cervix. The onset is gradual but the patient presents herself for emergency treatment with an extremely malodorous discharge. Examination will reveal the necrotic tissue in the vagina. The small polyps can be twisted off without much trouble or further symptoms. A prolapsing fibroid may fill the entire posterior portion of the vaginal canal and the cervix be palpable only as a small ring around it. Treatment consists in the delivery of the fibroid morcellating it if necessary. If bleeding is encountered it can be controlled by a pack with at least 5 gm. of sulfathiazole in the uterus and vagina. In the presence of severe infection hysterectomy if indicated should be delayed for three months. At the end of this time it can be carried out without difficulty.

If the presenting symptom is vaginal bleeding the history is all important. An embarrassed patient may completely neglect the fact that she had been married the day before. A fibrous hymen will often bleed considerably when torn but the bleeding is easily controllable with one or two sutures.

Vaginal bleeding from the cervix or uterus not associated with pregnancy is generally the result of a polyp and can be treated by dilatation and curettage and removal of the polyp. However if the patient is more than forty years of age vaginal bleeding should make one suspicious of carcinoma. Both the cervix and the uterus should be examined particularly

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possible intra uterine pack will control the situation temporarily.

Incomplete Abortions—These form the largest single group of gynecologic emergencies and it is variously estimated that one out of four pregnancies results in an abortion, miscarriage or premature fetus. The great majority of these occur in the first sixteen weeks of pregnancy.⁶ The abortion may be incomplete, complete or inevitable when the patient is first examined. The bleeding may be only moderate or it may be severe even to the point of exsanguination. If the

is similar to that of mittelschmerz and is in the lower part of the abdomen but without extension. Nausea, vomiting and rise of temperature are not remarkable. Shock is not a feature, as it is in case of ectopic pregnancy and there are no suggestive signs of pregnancy. The menstrual history gives the only suggestive leads in an increased dysmenorrhea. There is usually also a history of lack of conception perhaps one child, seldom more, and none recently.

Physical examination reveals a markedly tender cervix and uterine sacral ligaments. Nodules may be palpable behind the uterus. There are also lower abdominal tenderness and rebound tenderness but not a great deal of spasm. The diagnosis must be differentiated from the other lower abdominal emergencies and exploration is often necessary for "an acute abdomen."

Once the abdomen is opened the surgeon can make the diagnosis at once by the collapsed cyst and the characteristic chocolate-colored fluid in the pelvis. The only cure is excision of all ovarian tissue, the endometrial cysts are dependent on functioning ovarian tissue and their activity. If the patient is near the menopause the surgical treatment is bilateral oophorectomy with or without hysterectomy. If the patient is younger the decision as to radical surgical intervention versus conservative treatment with the preservation of some ovarian tissue must depend on the amount of pain and disability she has had and whether she realizes that she might again require surgical intervention. Unless the situation has been discussed preoperatively it is better to be conservative than radical if the patient is young.

Other Abdominal Emergencies.—Rupture of a capsular vein* a leiomyoma is a rare condition associated with all the signs of intra-abdominal hemorrhage plus the presence of a large pelvic tumor. The onset is typically sudden and is most often associated with trauma or physical activities. Treatment is exploration through a lower midline incision followed by hysterectomy. The ruptured vein should be looked for behind the tumor where it lies against the promontory of the sacrum.

According to Seed, degeneration or necrosis of a fibromyoma is found grossly demonstrable in 13 per cent of the cases in which oper-

the routine surgical list. Occasionally however, during pregnancy a fibroid degenerates and requires emergency operation. Myomectomy should be carried out if operation is necessary with the expectation that the pregnancy will continue. The symptoms are rather severe abdominal pain without a great deal of nausea or vomiting. There

position Some preparation of ergot should be used postoperatively to stimulate uterine contraction The pack can be removed safely in twenty four hours

One group of patients must be watched extremely closely and the prognosis to the family must be guarded These are the patients who have sepsis often as the result of criminal abortion The patient frequently has a low fever and low blood pressure and looks very sick but does not show much loss of blood These infections are generally overwhelming and the one hope is adequate chemotherapy Both sulfonamide compounds and penicillin should be used promptly

SUMMARY

An attempt has been made to review briefly the diagnosis and treatment of the acute gynecologic conditions requiring emergency surgical treatment In the two most important groups there has been a lowering of mortality and morbidity rates in recent years In the incomplete abortions it has been due to chemotherapy as well as to supportive treatment In ectopic pregnancy the mortality rate depends entirely on early treatment and preoperative and postoperative care with attention in particular to the restoration of the circulating blood volume

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hemorrhage is severe, supportive treatment with external heat, intravenously administered fluids, transfusions and so forth is started at

in the uterus and chemotherapy is started after operation if infection is present

When the bleeding is only moderate, treatment is instituted on the basis that the less that is done to the patient the better her progress will be and the fewer complications will develop. The patient is put to bed, kept warm and given sedatives and fluids administered intravenously. If her blood pressure is low the foot of the bed is elevated. Oxytocics are administered at once, then 1/320 grain (0.0002 gm) of ergotamine tartrate, every six hours by hypodermic. When the uterus is contracting gentle pressure will help it to expel the secundines. Laboratory tests are ordered immediately for erythrocyte count, leukocyte count, hemoglobin determination, grouping of blood, Rh factor and urinalysis. The patient is then given twenty four to forty eight hours to complete the abortion. If it is not completed in that length of time, dilatation and curettage will be necessary and should be carried out without further loss of time or expense to the patient.

Most of these patients are young, healthy women in an acute condition and intravenously administered pentothal sodium is the anesthetic agent of choice. If the patient has lost much blood, her tolerance of the anesthetic agent will be slight and 5, 10 or 15 cc of a 2.5 per cent solution may be sufficient for the entire procedure but 50 per cent oxygen with 50 per cent nitrous oxide should be given throughout the operation. Intravenous administration of fluids or blood is started preoperatively depending on the amount of loss of

The uterine cavity should then be explored with placental forceps

(pitressin) or ergonovine maleate (ergotrate) can be used intravenously if the uterus is large or the bleeding is brisk. When the surgeon

turning it into the vagina to leave the uterus well up in a normal

either primary in the adrenal or secondary to the typical pituitary changes"

It is considered by the majority of investigators that of the two ovarian hormones the estrogenic is the more vital in the relationship of the ovaries to the other endocrine glands

When the menopause is induced artificially the changes in the activity of the other endocrine glands naturally are more abrupt than those which occur when the menopause is spontaneous. For this reason the symptoms at the onset are likely to be more severe especially if the woman has had no previous ovarian dysfunction. This is true at any age. The young woman with a spontaneous ovarian failure does not as a rule suffer as much from the truly endocrine disturbances as does a young woman whose menstrual periods have been normal and who suddenly suffers castration. However because the menopausal symptoms are dependent not only on an endocrine imbalance but also on the psychosomatic reactions which are the result of the changed glandular physiology it is very difficult to predict in any certain case just how much disturbance the woman will experience. Many surgeons have had the experience of performing complete removal of all the pelvic organs for a cancer of the cervix for instance from a young woman who previously had normal ovarian function with surprisingly few menopausal symptoms resulting. It must be remembered that although menopausal symptoms develop in 85 per cent of women with spontaneous ovarian failure perhaps only half of these women experience difficulty sufficient to make them think they need treatment. If this number were considerably higher after the artificial induction of the menopause there would still be a fair number of women who would have only mild symptoms. On the other hand it is common knowledge that women who have had menopause artificially induced for them for any reason other than perhaps for a malignant process are likely to attribute not only the usual symptoms but also any bizarre disturbance appearing after the menopause to the loss of their ovarian function.

A few years ago at the Clinic we reviewed the records of a group of 140 women who had arrived at the climacteric for whom we had carried out determinations of the content of gonadotropic hormone in the urine. Thirty-four of the women were still menstruating but in 106 the menopause had been present from several months to ten years or more. Of these 106 forty-one had had artificial menopause induced for them.

The whole group of 106 women was divided into two subdivisions (1) those who had excessive or menopausal titers of gonadotropin in the urine and (2) those who did not. All the women who complained of marked and typical menopausal symptoms such as hot flushes, chills, nervous irritability, headache, dizziness, insomnia and

TREATMENT OF THE MENOPAUSE, WITH SPECIAL REFERENCE TO ARTIFICIALLY INDUCED MENOPAUSE

DELLA G. DAVIS

With the induction of artificial menopause by either surgical removal of the ovaries or castration irradiation there is known to ensue a sudden change in the secretory function of the remaining endocrine glands. We are best informed at present regarding those changes which take place in the anterior lobe of the pituitary gland. Severinghaus⁷ and others have described certain cytologic features of the acidophils and basophils as constituting evidence of a state of active elaboration and discharge of their secretory products at this time. Severinghaus said that "structural evidence of increased secretory activity of the anterior lobe at this time is in keeping with the presence of larger quantities of hormone presumably of pituitary origin which may be recovered from the urine of menopausal women."

That certain changes take place also in the thyroid and adrenal glands no one doubts whether these changes occur secondarily to the pituitary hyperfunction or primarily in these glands themselves as a result of the withdrawal of the ovarian hormones is not known as yet. Hoskins has called attention to the marked increase in vasomotor reactivity after the extirpation of the ovaries in dogs as shown by the response to injections of nicotine which is a selective sympathetic stimulant. "subsequent implantation of viable or ovarian tissue to a

⁷ That there is increased activity of the adrenal cortex as well as women

⁸ Many

called

after the

menopause. This has been called a cushingoid habitus and has been suspected of being a mild form of Cushing's disease. A recent thesis by Mellgren from the University of Upsala well establishes the point that enlargement of the adrenal cortex is typical of this menopausal syndrome. This enlargement and certain histologic features presented by the cortical cells are expressions of hyperfunction. Mellgren wrote "that the end of the normal menstrual cycles is in all probability attended by raised adrenocortical function

diminish in severity. When radium or roentgen ray castration has been employed, the symptoms seldom are manifested before the third month after treatment. We have found that the greater number of patients report for treatment within the first year after the menses cease.

It is well to discuss the whole situation at the outset with the patient who is to undergo castration, so that she may feel there is help for her if she needs it. For instance, if she had a malignant condition for which the menopause was induced. I believe it is best to advise her against taking estrogenic hormone, but to assure her that if she needs help, sedative agents are available. It is often surprising how such women will maintain themselves satisfactorily without any medication for their menopausal symptoms. In the example I have just mentioned the fear of recurrence of the malignant process may obliterate all the other fears. An occasional patient whose symptoms persist may continue to take barbiturates, a practice which no doubt has become a habit, but on the whole it has seemed to me that women who have undergone oophorectomy for malignant lesions give physicians less trouble than do those who have undergone this operation for conditions other than malignancy.

It is my feeling that a thorough discussion of the symptomatology of the menopause with the patient previous to its onset, if possible, allays many fears. When the patient asks for therapy alone

the physician must be careful. In such a case an anxiety state alone may be responsible. Hence, it is well to have a quantitative determination of the content of gonadotropic hormone in the urine carried out to determine if this hormone is present in excess amounts, also, it is wise to follow the effect of estrogenic hormone therapy by the taking of vaginal smears so that the response to the therapy can be evaluated. When the effect of the estrogenic hormone in the vagina is good the patient's symptoms should be either gone or greatly ameliorated. If they are not, something is wrong which means that the physician must look further to find the cause of the patient's symptoms.

I cannot enumerate here the many fears which women have in

the endocrine system. Such women seem suddenly to realize that older age is coming on, that child bearing will be over and that their period of greatest usefulness has passed. If the physician can elicit each woman's particular fear and offer her some reassurance, many of her psychosomatic complaints during this period will disappear.

mild depression were found to belong to the group in which menopausal titers of gonadotropin were present in the urine. These women had received no treatment. There were thirty three women in all and among these were nine for whom the menopause had been artificially induced. Of six women still complaining of severe symptoms ten or more years after the menopause four had had the menopause artificially induced.

In the second group of women who did not have an excess of gonadotropic hormone in the urine were forty three women who had typical mild symptoms. Some of these forty three women were receiving therapy with estrogenic hormone. Of these sixteen had had the menopause produced artificially. Among those who had passed the menopause by ten years or more there were nine women who were still complaining of mild symptoms for three of these the menopause had been induced. Also in this second group in which there was no excess of gonadotropic hormone in the urine were thirty women who complained of some bizarre symptom which they attributed to the menopause. For sixteen of these women the menopause had been artificially induced as was true likewise of all the six women still complaining of symptoms ten years later. Charts of this study have been previously published.

On the basis of results of this study it would seem possible to conclude that perhaps the women for whom artificial menopause is produced continue to experience the true endocrine disturbances over a longer period than do those for whom the menopause was spontaneous. Also it would appear that women who have had an artificial menopause are more likely to complain of bizarre symptoms and to attribute any such symptoms which they may have to the loss of ovarian function. Sometimes physicians also are likely to think that any woman for whom the menopause has been artificially induced must continue to experience related symptoms with the result that the woman is treated unnecessarily with hormones and to no avail.

It is well for the physician when he is faced with the necessity of bringing about an artificial menopause and especially in a woman who has fair ovarian function to bear in mind that there is at least a fair chance that the woman will have rather severe hot flashes and the other vasomotor symptoms known to accompany these.

The content of gonadotropic hormone in the urine begins to increase to three mild hot the surgeon which as a rule is about twenty one to twenty-eight days post operatively. The physician usually can predict and also can tell the surgical patient that her symptoms will be most severe from three months to a year after operation and that then they should begin to

therapy There are few women who cannot take the synthetic estrogenic hormone, stilbestrol, and obtain relief therefrom Nausea and vomiting are unusual if the daily dose is kept at or below 0.5 mg This is enough to stop the hot flushes within about two weeks, at the end of which the dose can be reduced to 0.25 mg, and administration can be continued for three months After a rest period, if the hot flushes return, 0.25 mg is often sufficient and, later on, 0.1 mg is enough After the menopause has been established artificially the physician does not need to worry about inducing bleeding when he administers the hormone, unless, in the case of surgical castration, the uterus unfortunately has not been removed During the first year, then, when symptoms are severe, more estrogen can be administered, if necessary Some women complain of increased nervousness when they are treated with stilbestrol, and prefer the natural estrogens A water soluble estrogenic substance, premarin, administered daily in a dose of 1.25 mg, does very well This dose later can be reduced to 0.62 mg If premarin is not potent enough, ethinyl estradiol (estinyl) is available in doses of 0.05 and 0.02 mg This is a synthetic product, but the chemical structure is similar to that of the natural hormone The effect of oral medication lasts only about forty-eight hours after medication has been discontinued The medication employed should be given daily In my experience, medication administered orally is more easily tolerated and not so easily forgotten when taken at bedtime, as might be true of agents administered otherwise

In the treatment of the atrophic disturbances often encountered after the menopause, estrogenic hormone again is helpful When the physician is dealing with simple atrophic vulvitis and vaginitis accompanied by a sense of fullness and soreness in the vagina and itching of the vulva, the local use of the estrogenic hormone in the form of vaginal suppositories or the oral administration of an estrogenic substance often gives entire relief In these cases it is usual to administer the estrogen for five or six weeks only The therapeutic effect of the hormone can be attained within ten to twelve days If this effect is maintained, then, for the best to warn her, treatment may need to be repeated

Leukoplakia of the vulva is treated surgically, by vulvectomy Es-

suspicious nodules, ulceration or fissure about the vulva, biopsy of a specimen of tissue should be performed before any hormone is administered

Such complaints will never be cured by means of hormone therapy. At times the physician may have had a patient who complains only of one feature of the typical hot flush, such as tachycardia. She has a fear of heart disease. She will benefit from hormone therapy if the tachycardia is explained as being an accompaniment of the hot flush and she is reassured as to her heart.

Fatigue and tension states are common also during this period because of interference with the patient's sleep by the hot flushes and also by true menopausal insomnia. In these cases barbiturates often are very helpful at the beginning of the treatment, in association with hormone therapy. At the Sloane Hospital for Women in New York City, Buxton said, it is the practice to begin treatment with barbiturates. An agent such as $\frac{1}{4}$ grain (0.016 gm) of phenobarbital is administered three times a day after meals and 1 grain (0.065 gm) is administered at bedtime. It was said that such medication would bring relief to slightly more than half of the patients in that hospital. All types of patients were included in the group mentioned by Buxton.

With the administration of estrogenic hormone in sufficient doses, the distressing vasomotor waves or hot flushes and other symptoms often associated subside. Insomnia is controlled, fears and feelings of inferiority depart, and a sense of well being again develops. Enough hormone should be administered during the first ten days or two weeks of treatment to stop the flushes. The dose can then usually be reduced, but the physician should continue to administer sufficient hormone to hold the symptoms in abeyance for at least three months to allow the woman a chance to feel like her former self for a time. This gives her confidence that there is some help for her if she needs it. Then, the dose of hormone can be reduced gradually over a period of another month, and use of it can finally be stopped for a month. Sudden withdrawal of the hormone may increase the hot flushes. If necessary, then, the course of treatment can be repeated. The second course of therapy generally can be less than the first.

The hot flushes or vasomotor waves disappear first with the treatment. Insomnia and simple depression disappear slowly, larger doses of hormone may be necessary when these are present. It is well known as Fluhmann has pointed out, that the menopausal symptoms subside with the administration of much less estrogen than is required to reduce the titer of the gonadotropic hormone in the urine. This is perhaps the reason why, in many women the symptoms return when administration of the hormone is stopped. The high level of gonadotropic hormone may persist for years in some women. The oldest of our patients was a woman seventy years old who had never had any treatment and was still having typical symptoms twenty years after her periods had ceased.

Oral estrogenic therapy has practically supplanted intramuscular

PREMENSTRUAL EDEMA

LOIS A. DAY

PREMENSTRUAL edema and certain menstrual disorders are objective signs of the syndrome of ovarian hypofunction. Antedating frequently the appearance of the objective signs of the syndrome are the subjective symptoms. Since these symptoms are complained of by younger, menstruating women they are frequently attributed to neurasthenia.

The subjective symptoms of this disorder are those produced by a disturbance of the function of one or several of the systems of the body. Many symptoms, consisting of excitability, feeling of tension, failure of memory and inability to concentrate are referable to the central nervous system. The patient frequently wakes about 2 or 3 A.M. and cannot go back to sleep. Many times she is aware of an occipitofrontal headache which persists on rising. The function of the circulatory system is frequently disturbed. In addition to hot flushes the patient may experience tachycardia, palpitation and cold hands and feet. A sense of substernal oppression frequently causes her to seek medical aid as she fears that she has organic heart disease. The otolaryngologist sees a number of these women because of disturbing tinnitus and dizziness. Other patients are plagued by gas, bloating and constipation. They may also have a sense of soreness in the lower part of the abdomen, which they frequently describe as a "rawness." In addition to the symptoms produced by disturbances in the various systems most of these patients complain of a sense of exhaustion and easy fatigability. A large element of fear exaggerates the symptoms, as the patient feels that something serious must be wrong, otherwise she would not feel so "terrible." The bizarreness of the symptoms may be explained by the variation in the degree of ovarian hypofunction in different individuals. This is determined in turn by the causation of the condition.

If these cases are divided according to causation they fall into five groups. Group 1 contains those cases in which symptoms and signs develop because of a constitutionally inferior genital apparatus. Careful review of the family history will usually reveal the fact that some of the patient's progenitors have had difficulties with their menses or pregnancies or have had surgical treatment for pelvic tumors. In group 2 are those cases in which the trouble develops after a pelvic operation. An ovary or both ovaries have been removed or some type of suspension operation has been performed that has probably interfered with the blood supply to the pelvic viscera. In group 3 are the

SUMMARY

In summary, it can be stated that there is little difference between the treatment of artificial menopause and the treatment of spontaneous menopause. The symptoms of the artificial menopause may be more severe because the castration changes in the glands of internal secretion which induce the characteristic vasomotor disturbances are brought about more abruptly than when spontaneous menopause occurs.

It would seem from our studies that the postmenopausal symptoms are not only likely to be more severe during the first year after castration, but that they also will last longer, because more women treated by castration were still complaining at the end of ten years.

The psychosomatic reactions were more commonly noted after the artificially induced menopause, in such cases, in which symptoms are atypical we have found studies of the titer of gonadotropic hormone in the urine to be of considerable help in decision as to whether or not estrogenic hormone therapy is justifiable.

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group of forty-two healthy young women, noted a gain of 3 pounds (1.4 kg) or more in 30 per cent of them prior to the menses. A similar though not so marked gain of weight has also been noted at the time of ovulation. The incidence of other symptoms, such as tenseness, irritability, increased motor activity, crying spells, headaches, vertigo, insomnia, painful breasts, dysmenorrhea and ulcerative stomatitis and vulvitis, has been studied by Ziserman, Israel and Werner.

Various case reports have served to call attention to some of the more severe manifestations of the syndrome. Thomas in 1933 reported two such cases. In the first case, a woman twenty nine years of age sought medical aid because of bitemporal headaches, blurred vision, vomiting, swelling of the hands, face and body, oliguria and a premenstrual gain of 10 to 12 pounds (4.5 to 5.4 kg). Following the onset of menstruation she experienced polyuria, return of her weight to normal and disappearance of her other symptoms. The second patient, a woman thirty eight years of age, complained of headache, blurred vision, prostration, nausea and swelling of the face, body and extremities which occurred with each period. Following the onset of menstruation she would void large amounts of urine, as much as 4,500 cc in twenty-four hours, and promptly recover. In the interim between the periods she was well and active. In neither case was there any evidence of intracranial disease, though at the height of her symptoms the second patient had choking of the optic disks, which disappeared with the disappearance of the edema.

McCullagh in 1941 reported an even more striking case. His patient, a woman twenty four years of age, complained of headaches, diplopia and puffiness of the hands and face. At the time when these symptoms were at their height she was found to have bilateral choked disks of 3 diopters with enlargement of the blind spot. Increased spinal fluid pressures were recorded at the height of the edema and headache. No evidence of an intracranial lesion was found. The only chemical abnormality was a high concentration of sodium in the blood. Dehydration therapy and the use first of A.P.L. and later of diethylstilbestrol controlled the patient's symptoms.

REPORT OF CASES

The following case reports will serve to re-emphasize the clinical picture. The hormonal assays may shed some light on the hormonal disturbance responsible for the condition.

CASE 1—The patient came to the Clinic in March, 1938. She was thirty three years old, the mother of two children, aged thirteen and eleven years. A year after the birth of the last child she had had one other pregnancy that had ended in an abortion at the third month. Her husband had been married for five years, the n

cases in which the trouble develops after an inflammatory process in the pelvis. Many of these processes are local in origin, being caused by a neisserian infection or sepsis following pregnancy, abortion or surgical treatment. Others are secondary to a generalized abdominal process which subsequently localized in the pelvis.

pregnancy
clear but
of ovarian

hypofunction develop after a pregnancy

Group 5 contains the cases in which symptoms appear secondary to debilitating disease elsewhere in the body, after psychic or physical trauma or after various types of dietary restriction. This latter group of cases, in contrast to the other four, exhibits the symptoms in a more transitory manner. Correction of the causative agent is usually simpler and followed by more rapid improvement while in the other four groups the etiologic agent is not so easily corrected and treatment is more often substitutional in character. Another point of importance in the administration of substitutional therapy is the fact that ovarian hypofunction tends to become intensified with aging and the dose of

with the passage of time
encountered. Mild degrees are
in the menstrual cycle, mild pelvic

pain, soreness of the breasts and moderate premenstrual gain of weight. In cases with more marked hypofunction there are more pronounced menstrual irregularity and associated symptoms such as hot flushes, insomnia, headaches and pronounced premenstrual gain of weight.

swelling of the face, hands and feet with concomitant decrease of urinary excretion. Excretion of female sex hormone in the urine

present in the severest cases of this nature—temporary or permanent amenorrhea brought about by roentgen treatment appears to be the proper procedure.

Other investigators since have studied the incidence of the various

She had no gastro intestinal symptoms except constipation and had to resort to almost daily use of a laxative. Her menstrual periods had started at the age of fifteen years. They were regular every twenty eight days with a scant three day flow during which time she used a total of six pads. The flow was associated with severe lower abdominal cramps, backache and the headache mentioned previously.

The physical examination showed the patient to be 5 feet 3 inches (160 cm) tall and to weigh 144 pounds (65.3 kg). Her blood pressure was 110 mm of mercury systolic and 70 diastolic and pulse rate 80 beats per minute. Her hair was coarse and dry. There was rather marked edema of the tissues around the eyes and of the eyelids. The hands were puffy but there was no pedal edema. The remainder of the examination including that of the pelvis gave negative results.

The urine did not contain sugar or albumin and had a specific gravity of 1.020. The concentration of hemoglobin was 14.5 gm per 100 cc of blood (96 per cent). Roentgenograms of the thorax and head were negative. Examination of the ocular fundi gave negative results. The basal metabolic rate was +20 per cent. She was advised to discontinue taking thyroid and to return in a month for observation and a recheck of the metabolism. She was not seen again for three months at the end of which time the basal metabolic rate was +12 per cent. She was given a sedative to use at the time of the menses for the cramps. She was next seen at the Clinic in October 1937. During the interim she had married and came now for prenatal care. She was approximately three months pregnant. Her blood pressure was 100 mm of mercury systolic and 70 diastolic and she weighed 146 pounds (66.2 kg). The basal metabolic rate at this time was -3 per cent. The concentration of hemoglobin was 12.3 gm per 100 cc of blood (81 per cent). Urinalysis gave negative results with a specific gravity of 1.016.

During the prenatal period despite an effort to control her weight it increased from 146 to 199 pounds (66.2 to 90.3 kg). In the last month she had marked edema and elevation of the blood pressure on several occasions to 140 mm of mercury systolic and 100 diastolic. She was treated in the usual manner for pre-eclamptic toxemia, went to term and gave birth spontaneously to a normal male infant. The infant weighed 7 pounds 6 ounces (3.35 kg). The mother's post partum course was uneventful except for the fact that she could not nurse the infant because of inadequate lactation.

The patient came under my personal observation in September 1939 at which time the baby was one year four months old. She came again complaining of swelling of the eyes and hands which had become more marked in the last three months. The swelling varied in amount increasing about one week before the expected period. She noted that her weight increased 5 to 6 pounds (2.3 to 2.7 kg) during this period. Her breasts became tender and engorged premenstrually. She had increased thirst but had not noted increased urinary output at this time. She was sleepy and tired all the time and experienced a feeling of depression. She had noted a marked decrease of libido. The menses which had previously been twenty-eight days apart were becoming closer together so that the last several periods had occurred every two weeks with a prolongation of the flow for a period of eight to ten days. She had a severe headache which preceded the onset of the flow by two or three days and lasted for the first two or three days of the flow.

The patient's physical examination gave negative results except for the presence of rather marked edema of the tissues around the eyes and of the eyelids (fig. 287). The features of the entire face appeared coarse and broad. She was rather slow in response to questioning and had a lethargic appearance. There was some puffiness of the hands. Her blood pressure was 90 mm of mercury systolic and 60 diastolic. She weighed 160 pounds (72.6 kg). Her basal metabolic rate

scant periods she complained of the following symptoms. About one week before the anticipated period she noted the onset of swelling of the face, eyelids, fore arms and abdomen which was so marked that her clothing was uncomfortable. She would gain as much as 10 pounds (4.5 kg.) during this time and had noted that she passed little urine. She had many hot flushes and some frontal headaches of moderate severity. At this time of the month she was intolerant of the heat and had on occasion taken her temperature and found it to be elevated to 100° F. In 1935 her pelvis had been explored and uterine suspension and bilateral resection of the ovaries had been performed. After this procedure she had been bothered with a dull pain in the right lower quadrant of the abdomen and increased severity of the other symptoms.

The patient was at the Clinic under observation for a period of five days which was not long enough to follow her through one of the periods of gain of weight. She was at the seventeenth day of the cycle at the time my colleagues and I first saw her. Her general physical examination and examination of the pelvis gave negative results. Her blood pressure was 138/90 and 140/100 in mill

protein per 100 cc. of serum with an albumin globulin ratio of 2.2. A syphilis test for syphilis gave negative results. Roentgenograms of the thorax and sella turcica were negative. The basal metabolic rate was -2 per cent.

Twenty four hour urine collections were assayed for estrogen, prolactin and pregnandiol. Forty rat units of estrogen per twenty four hours was found at the seventeenth day of the cycle and 10 rat units per twenty four hours at the twentieth day of the cycle. The average normal value for estrogen at this time of the cycle is 35 rat units. Urinary prolactin and pregnandiol were found normally menstruating.

There was 0.597 mg. of pregnandiol in a twenty four hour amount of urine at the nineteenth day of the cycle. The average normal value is 5 mg. per twenty four hours. An endometrial biopsy showed an early differentiative phase of the endometrium on the eighteenth day of the cycle.

The patient returned home to her local physician for treatment. It was suggested that he give her a trial of estrogenic therapy. There is no further follow up on this case at the time of writing of this paper.

CASE 2—The patient was first seen in the metabolic section of the Clinic in 1936. She was a nineteen year old student nurse and was sent in by the nursing supervisor because someone suspected that she had disturbance of the thyroid gland. About one year before this—because of puffiness of the tissues around the eyes and of the hands, lethargy and fatigability—she had been seen at the

metabolic section of the Clinic. However, the edema did not disappear after a month of treatment.

bestrol and that this was interfering with the menstrual rhythm. Twenty four hour samples of urine were collected at this time and assays showed the urine to be negative for excessive amounts of gonadotropin and to contain 158 rat units of estrogen in the twenty four hour specimen. The dose of diethylstilbestrol was reduced to 1 mg a day in the second half of the cycle. The October period started on October 23 and lasted for six days with a total of six pads. The next period of flow started on November 8 and lasted six days. The patient menstruated again from November 23 to November 27. The dose was changed from 1 to 0.5 mg a day to be taken from the time of the cessation of the flow and stopping four to five days before the next anticipated flow.

The patient was seen again four months later. During the intervening period the menses had occurred regularly every four weeks with a four to five day flow of moderate amount. The edema was well controlled and her weight was fairly constant around 150 pounds (68.0 kg). The headaches were mild and occurred only a few hours before the onset of the flow. The next time she came was



Fig. 288—The same patient as in figure 287. The edema of the tissues around the eyes and of the eyelids has disappeared.

several months later. She reported that she had stopped the medication for a period of a month to see if she could do without it. During this time she had gained 7 pounds (3.1 kg).

could meet to take it in this manner.

We saw her again at the end of this time, October 1941, when she came in to say good by as she was moving from Rochester. We have had a report from her approximately twice a year since that time and have seen her on one occasion during July 1945. During these four years she had attempted on several occasions to go without the drug. The last period she had gone without it was six months before her last visit. She had however started to take the medication again about a month before we saw her. During the time she was not taking the medication her weight increased from 150 to 166 pounds (68.0 to 75.3 kg) and the headaches recurred four days before and during the period

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ometrial biopsy was done at the same time. It was impossible to tell what it was thus was in the cycle because of the irregularity but it can be stated that the next period of bleeding following the biopsy occurred five days later September 26 1939. The endometrium was in the early differentiative phase of the cycle. There were 21 rat units of estrogen present in a twenty four hour amount of urine and 40 rat units of gonadotropin present per liter.

Oral administration of 2 mg of diethylstilbestrol a day was begun after the next episode of bleeding. The period came on again in seventeen days. The cramps were not much different but the patient felt much better generally. The edema was less the headache came on the evening before the onset of the bleeding and was gone the next day. During the next four months her periods



Fig. 287—Edema of the tissues around the eyes and of the eyelids

became regular every twenty eight days with a flow of four days. By January 1 1940 (Fig. 288) her weight had dropped to 155 pounds (70.3 kg). The headaches were not bothersome. She had only mild discomfort with the flow. The February period occurred at the correct time. She did not menstruate in March and started to menstruate the middle of April 1940. The flow was excessive for a period of three days and she was treated on the supposition that abortion was inevitable. However we saw no tissue and she was not aware of passing any. She discontinued the medication for a period of six weeks during which time the edema around the eyes started to recur. She was advised to return to the former method of taking the diethylstilbestrol.

The May period started on time and was normal. The June period was delayed for two weeks and the patient menstruated only one day. She did not menstruate again until August 8 when she had a very scant one day flow. My colleagues and I felt at this time that she must be getting too much diethylstil

bestrol and that this was interfering with the menstrual rhythm. Twenty-four hour samples of urine were collected at this time and assays showed the urine to be negative for excessive amounts of gonadotropin and to contain 158 rat units of estrogen in the twenty four hour specimen. The dose of diethylstilbestrol was reduced to 1 mg a day in the second half of the cycle. The October period started on October 23 and lasted for six days with a total of six pads. The next period of flow started on November 8 and lasted six days. The patient menstruated again from November 23 to November 27. The dose was changed from 1 to 0.5 mg a day to be taken from the time of the cessation of the flow and stopping four to five days before the next anticipated flow.

The patient was seen again four months later. During the intervening period the menses had occurred regularly every four weeks with a four to five day flow of moderate amount. The edema was well controlled and her weight was fairly constant around 150 pounds (68.0 kg). The headaches were mild and occurred only a few hours before the onset of the flow. The next time she came was



Fig 288—The same patient as in figure 287. The edema of the tissues around the eyes and of the eyelids has disappeared.

several months later. She reported that she had stopped the medication for a period of a month to see if she could do without it. During this time she had gained 7 pounds (3.2 kg) more than the average that she had been maintaining. The headache had returned and the edema around the eyes was apparent again. We decided to have her try taking 0.5 mg of the drug throughout the cycle. This dose proved to be very satisfactory in controlling the symptoms and she continued to take it in this manner.

We saw her again at the end of this time, October, 1941, when she came in to say good by as she was moving from Rochester. We have had a report from her approximately twice a year since that time and have seen her on one occasion during July 1945. During these four years she had attempted on several occasions to go without the drug. The last period she had gone without it was six months before her last visit. She had, however, started to take the medication again about a month before we saw her. During the time she was not taking the medication her weight increased from 150 to 166 pounds (68.0 to 75.3 kg) and the headaches recurred four days before and during the period

The menses became irregular and occurred every two to three weeks with a prolonged flow of six to eight days. She noted increased nervousness and sleeplessness and a loss of libido. The edema around the eyes recurred and the hair became dry and brittle. After the resumption of the medication for a period of a week, the patient felt improved and began to lose weight. When we saw her a month later her weight was 150 pounds (68.0 kg), there was no edema present and she was feeling much improved. The urine was negative with a specific gravity of 1.020. Roentgenograms of the thorax and head were negative. The urinary estrogen was 25 rat units per twenty-four hours and the assay for gonadotropin positive for excess amounts (+25 rat units per liter). She was advised to continue with the same dosage of diethylstilbestrol that she had been taking.

COMMENT

The cause of the physical and mental disturbances seen in some women preceding menstruation is not definitely known. Frank was the first to suggest a hormonal pathogenesis. On the basis of experimental and clinical data he concluded that the syndrome is due to hyperestrinism.

Thorn and his associates^{14, 15} have studied the electrolyte and water balance of animals into which large doses of the crystalline sex hormone (estrone, estradiol and progesterone) had been injected. In these animals there was a striking but temporary retention of sodium, chloride and water, which was followed in a period of five days by a rebound effect and loss of the retained sodium, chloride and water. Thorn and his associates observed that almost half (twenty-four of fifty) of a group of normal female subjects gained 1 kg. or more during the week preceding menstruation. In twenty-four to seventy-two hours after the onset of menstruation, diuresis occurred and the subjects lost weight. A similar though usually not so marked gain of weight occurred at the time of ovulation. While some of this gain of weight can be explained by an increased food intake, carefully controlled balance studies showed that under constant dietary conditions the premenstrual gain of weight was associated with a retention of sodium, chloride and water. Studies of the urinary excretion of the female sex hormone during the same period indicated a fluctuation which could be correlated in most instances with the cyclic changes in the excretion of sodium, chloride and water.

Such cyclic changes were observed¹³ in a patient who had undergone hysterectomy but whose ovaries were intact. Another patient who had undergone both hysterectomy and oophorectomy did not show significant fluctuation in the urinary excretion of electrolytes during a thirty-day period. This patient had had episodes of premenstrual edema prior to the operation eighteen months previously. Her urine contained a rather high titer of follicle stimulating hormone but no estrogen.

of electrolytes is more striking during the premenstrual period than at the time of ovulation suggests the possibility that progesterone or progesterone in addition to estrogens is more effective than the estrogens alone. Experimental studies have shown that progesterone has an effect on electrolyte balance that closely resembles the effect of the adrenal cortical hormone. Furthermore it has also been shown to increase the survival period of adrenalectomized animals an effect which parallels its ability to maintain the electrolyte balance of animals.

Quoting Thorn and his co workers further they say

"It seems unlikely that an increase over normal in the secretion of sex hormones is the factor responsible for the premenstrual edema noted in these patients. They have concluded "that premenstrual edema is probably the result of normal cyclic changes in sex hormone secretion acting as a precipitating factor in patients with some underlying change which predisposes to excessive retention of sodium chloride and water. Sodium restriction and supplementary potassium medication were effective in moderating the sodium chloride and water retaining effect of both gonadal and adrenal cortical hormones."

Greenhill and Freed have reported good clinical results in patients with salt restriction and administration of ammonium chloride premenstrually.

Some doubt that there is a disturbance of the electrolyte balance causing the syndrome has been cast by recent studies of Greisheimer and her co workers and Danforth Boyer and Graff. Greisheimer and her co workers in a study of thirteen women who had premenstrual tension were unable to demonstrate any typical changes in the acid base equilibrium of the serum. Danforth Boyer and Graff in a study of six normal women found no constant pattern of sodium phosphorus or total base. On statistical analysis however their data did show an elevation of the body weight at the time of the menses and a simultaneous decline in the hematocrit and plasma proteins.

Teel and Reid have questioned whether estrogens are responsible for the retention of water encountered in the syndrome. They were unable to inhibit diuresis in rats with estrone and estriol. They demonstrated the presence of an antidiuretic substance in the urine of the majority of women who had toxemia of pregnancy with edema and one patient who had premenstrual edema. They found that this substance was not ether soluble and therefore probably not an estrogen. They suggested that the effect of the sex hormones on water metabolism may be mediated through the pituitary gland.

Robinson and Farr were able to demonstrate some correlation between clinical edema and the amounts of antidiuretic substance in the urine. They studied one patient who had premenstrual edema and found moderate amounts of antidiuretic substance in the urine during the edematous period and none when she did not have edema.

We feel that in our two cases the patients' symptoms were due to ovarian hypofunction. Confirmation of the clinical impression came from the hormonal assays, which showed excess amounts of prolactin. In such cases estrogen therapy is indicated to remedy the hormonal imbalance. In addition to estrogen, treatment with drugs that will produce dehydration, as suggested by Thorn and his co-workers and by Greenhill and Freed, is of help.

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FUNCTIONING OVARIAN TUMORS

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THERE are five distinct types of functioning ovarian tumors, and there is an accessory group of such lesions which includes strumal tumors and Brenner tumors. The present paper will deal with the definition, histogenesis, incidence, age of the patients concerned, symptoms and signs produced by the lesions, results of laboratory studies, surgical and microscopic findings, and treatment and prognosis in respect to the several neoplasms, preceded by mention of certain embryologic features. Considerations of space preclude the inclusion of a bibliography in the present paper, but the writer can refer the reader to a review of the literature on ovarian tumors up to 1945¹.

EMBRYOLOGIC CONSIDERATIONS

The pluripotentialities ascribed by earlier writers to the germinal epithelium have been questioned recently by Fischel, who demonstrated that theca cells and granulosa cells actually originate in the mesenchymal core of the ovary. Additional support for such a contention is provided by the fact that granulosa cell tumors and theca-cell tumors produced experimentally by roentgen rays have been interpreted as arising from mesenchymal cells rather than from their prototypes or from germinal epithelium. It is known, also, that under certain conditions such dissimilar agents as pituitary hormones and ordinary zinc sulfate can produce gonadal tumors, although the precise origin of such tumors has not yet been established unequivocally. The existence of the gonad itself, Danchakoff wrote, depends on certain extragenital cells which wander into the genital ridge. Results of Danchakoff's experiments need to be confirmed, but the course of her investigations, like that of other recent workers, suggests that the germinal epithelium in itself no longer is accepted unquestioningly as the site of origin of some of the neoplasms concerned herein.

Hence, in view of the present status of knowledge, it is apparent that paradoxically enough even though certain normal cellular elements and abnormal cellular "rests" are contained in the ovary, histologic similarity between these elements and certain ovarian tumors does not necessarily indicate histogenetic relationship. In the present paper this fact has been kept in mind.

DYSGERMINOMA

Definition—A dysgerminoma is an unusual neoplasm which can affect the gonads of males, females and hermaphrodites. Microscopic-

ally, a dysgerminoma resembles the undifferentiated gonad in an early stage of embryonic development. A dysgerminoma cannot truly be construed as functioning, but its previously reported great frequency of occurrence in sexually "neutral" persons has caused the lesion to be regarded as a neutralizing tumor.

Histogenesis.—In the testis of the dog tumors similar to dysger

of the lymphocytic component suggests that the dysgerminoma has a teratomatous character. Meyer, pointing out that, histologically, the dysgerminoma resembles the "embryonic" gonad (male and female), wrote that the lesion arises from neutral or dysgerminomal cells. The high frequency of occurrence of dysgerminoma among pseudohermaphrodites, and the finding of the neoplasm in association with maldeveloped and misplaced testes lends some support to this assumption.

Incidence.—Approximately 200 cases of dysgerminoma have been reported in the literature. These cases represent perhaps only a modest portion of the number in which a dysgerminoma actually is removed and labelled "atypical sarcoma." Thus, it is seen that it would be virtually impossible to determine the true incidence of dysgerminoma, since the literature is misleading and since even in large series of ovarian tumors only an occasional tumor of this type will be encountered.

Age.—The tumors can occur in persons of any age. Most of them are found in women less than twenty years old. As a rule seminoma of the testis is a tumor which attacks young or middle aged men.

Symptoms.—Clinical pseudohermaphroditism once was a common feature in the cases of dysgerminoma recorded in the early literature. It is now recognized as a coexisting state rather than as a result of function of the tumor. This type of pseudohermaphroditism is not affected by removal of the tumor. Recently cases have been reported in which dysgerminomas complicated pregnancy. In brief it can be stated that there are no symptoms which are clinically diagnostic of dysgerminomatosis. Like seminoma of the testis dysgerminoma is likely to grow rapidly.

Results of Studies of Hormones.—At times seminoma of the testis and ovarian dysgerminoma are associated with the excretion of excessive amounts of gonadotropic hormones in the urine. Positive re

aspects of dysgerminoma also require much investigation, but in the

meantime they furnish us with an additional excuse for including dysgerminoma in the group of functioning ovarian tumors

Gross Surgical Observations—The tumors which occur bilaterally in a third of the cases generally are large solid and invested by a thin capsule. The cut surface is characteristically brownish red with scattered areas of necrosis and hemorrhage. The consistency of the neoplasm is extremely soft almost that of brain tissue. Adhesions often develop between these tumors and neighboring structures. In some cases numerous metastatic implants are disclosed at the time of operation

The tumor cells never seem to differentiate into glands, alveoli and papillary folds. Dysgerminoma duplicates seminoma of the testis and like seminoma it is always highly malignant from a cytologic standpoint

Treatment—It is true that unilateral encapsulated dysgerminomas in young women have been treated by local surgical excision yet results of recent studies demonstrate that the over all rate of recurrence is almost 80 per cent. Consequently when the tumor is found to be adherent when the patient is in her late thirties or when she has an infantile type of uterus radical surgical procedures should be imperative. Under other more favorable circumstances where the condition has been treated surgically by less radical measures careful follow up examinations are necessary in view of the possibility of recurrence and the danger that a similar tumor may arise in the remaining ovary. The original neoplasms and presumably the recurrent lesions are extremely sensitive to the effects of roentgen rays

THECA CELL TUMOR

Definition—A theca cell tumor is a solid ovarian tumor composed of cells resembling those of the theca folliculi. Such a tumor sometimes is associated with the production of estrogen and with feminization

Histogenesis—In the experimental laboratory the somewhat logical assumption that a theca cell tumor originates from mature theca cells recently has been questioned. Results of studies on roentgen produced theca cell tumors in mice have favored the theory that such tumors are derived histogenetically from the ovarian mesenchyma. That many of the tumors did not occur in pure form but rather seemed to contain an admixture of granulosa cells has prompted many workers to place the theca-cell tumors and granulosa cell tumors in a common group termed "feminizing mesenchymomas." However it is nonethe-

less true that some of the tumors of human beings and animals appear to be composed entirely of theca like cells, with the result that the majority of gynecologists accept this oncologic newcomer as an entity

Incidence—Approximately 100 cases have been reported since Loeffler and Priesel first described this particular ovarian tumor in 1932

Age—Theca cell tumors are essentially tumors of older women. About 65 per cent are found among women who are in the post menopausal age group. The tumors seldom are encountered among persons less than thirty years old

Symptoms—The symptoms caused by theca-cell tumors do not differ from those recorded for granulosa-cell tumors, if the corresponding age periods of the patients concerned are considered and if it is remembered that theca-cell tumors do not occur in childhood. Theca cell tumors do not so consistently produce significant quantities of estrogen and, accordingly, they do not always give rise to menstrual disturbances. When an estrogenic influence is present, the resultant bleeding may have a basis in uterine carcinoma which, as is true also of granulosa cell tumor, is a complication of too frequent occurrence for it to be explained purely on the basis of chance

The physical observations and the results of laboratory studies do not differ materially from those recorded for granulosa-cell tumor. Diagnosis will not often be made prior to surgical exploration of the pelvis

Gross Surgical and Microscopic Observations—Nearly all theca-cell tumors are solid. Usually they are of moderate size (5 to 10 cm. in diameter). Encapsulation generally occurs. In a typical tumor the yellow color is noteworthy; in others the appearance of the tumor may vary from grayish yellow to brown. The coarse whorled, fibrous character of the cut surface of the tumor may suggest an ovarian fibroma. The contralateral ovary frequently is atrophic, possibly because of the

plump spindle shaped pure theca-cell tumors the addition of granular and fatty fibroma for specific lipid substances or a chemical analysis of tumor tissue. Theca-cell tumors have a relatively high concentration of phospholipids. Mitosis is rarely a feature. Nearly all such tumors are to be regarded as being benign

Treatment—It is easier to treat a woman who has theca cell tumor than it is to treat a woman who has granulosa-cell tumor. In most

instances, theca cell tumors occur among older persons, which means that the need for conservatism is not dictated by regard for the possibility of future pregnancy. The incidence of associated uterine fibromyoma and of uterine carcinoma is fully as great as with granulosa cell tumor. Hence, removal of the uterus along with the fallopian tubes and ovaries may be prophylactic as well as curative.

GRANULOSA CELL TUMOR

Definition—A granulosa cell tumor is a feminizing ovarian tumor consisting of cells which histologically resemble in appearance and often in arrangement the cells of the granulosa and, which like them, are capable of elaborating estrogen.

Histogenesis—It was originally believed that granulosa cell tumors arise directly from granulosa cell rests in the ovarian cortex or medulla or directly from ovarian follicles. It is now generally agreed, however, that the tumors originate from undifferentiated ovarian mesenchyma. In mice in which ovarian follicles have been completely destroyed by roentgen rays, functioning granulosa cell tumors appear to arise from this primitive type of mesodermal tissue. The role that the pituitary body may play in the process is apparent in the results of another experiment in which female rats are castrated and bits of ovarian tissue are implanted into the spleen. When transplantation is successful the estrin elaborated by the transplanted tissue is filtered through and destroyed by the liver before it reaches the general circulation. Granulosa cell tumors which occasionally develop within these grafts have been explained on the basis of an unopposed action of pituitary gonadotrophic hormone.

Incidence—Granulosa cell tumors are not rare. About 600 examples have been reported in the literature. In view of the current accuracy of detection the frequency of occurrence of granulosa cell tumor probably reaches 2 per cent in any considerable group of ovarian tumors, and 10 per cent in the group of sex cord stromal tumors.

Age—In 5 to 10 per

cent has reached the

the lesion arises during the period of sexual maturity of the patient. In the remaining instances the neoplasm develops after the menopause has passed.

Symptoms—When a patient is in the pre adolescent years, granulosa cell tumors bring about both sexual and somatic precocity. Menses among such patients may commence during the first year of life. Although a certain regularity of flow may be noted, the bleeding is anovulatory, the breasts enlarge, pubic and axillary hair appears early, and body growth is accelerated, in association with notably early ripening of the bony epiphyses.

When granulosa-cell tumors develop in sexually mature women somatic changes do not occur and sexual changes are somewhat variable. Results of recent investigations however have shown that short or long periods of amenorrhea are the chief feature of the clinical history in more than 50 per cent of such cases. Moreover it has been found that patients almost invariably begin to menstruate within forty eight hours after the tumor has been excised. Resumption of menstruation after excision of such a tumor is suggestive of withdrawal of estrogen whereas amenorrhea can be produced experimentally.

Irregular bleeding in the blood
of granulosa cell tumor the presence
of granulosa cell tumor fluctuations
in the level of estrogenic hormone in the blood stream resulting from infarction and degeneration which from time to time occur within the substance of the tumor. As is true in cases in which the tumor appears before adolescence the bleeding is anovulatory. Reports of pregnancy associated with the presence of even small tumors of this type are very rare.

Among those patients who have passed the age of menopause irregular or semiperiodic bleeding is as a rule the presenting symptom. In other words it is discontinuous and actually is much more than mere spotting. These two characteristics sometimes help to distinguish it from the bleeding caused by carcinoma of the uterus.

Signs—When the aforementioned symptoms are present all the larger of the causative ovarian tumors will be palpable on bimanual pelvic examination. The concomitant finding of a large uterus in a patient who has passed the age of the menopause will be confirmatory evidence.

Laboratory Studies—Estrogen in excessive amounts has been demonstrated in the blood and urine of patients who have granulosa cell tumors. Bio assays of tumor extracts on the other hand usually demonstrate no hormone or only small traces of it. This fact suggests that the hormone is passed directly into the blood stream or that it is secreted intermittently. So far as I am aware the secretion of progesterone has not been demonstrated in any tumor of this type.

Gross Surgical Observations—The surgeon will encounter a granulosa cell tumor as a unilateral usually encapsulated round or lobulated mass with a brownish gray glistening capsule. The texture of the tumor generally is solid. The cut surface often has a soft con-

that a granulosa-cell tumor 1 cm in diameter may be responsible for the feminizing symptoms described herein. As a rule the uterus is

twice the size that would be expected, and in perhaps 70 per cent of cases it will be found to contain fibromyomas. In a surprising number of cases an independent carcinomatous neoplasm of the uterus will be encountered. These three associated lesions—namely, uterine myo hypertrophy, leiomyoma and fundal or cervical carcinoma, with an occasional concomitant mammary carcinoma—may be attributed, etiologically, to the presence of the ovarian tumor and its estrogenic influence. Considerable experimental evidence supports this view.

Microscopic Studies—The ovarian tumor is seen to be composed of granulosa like cells arranged in follicular, trabecular and diffuse patterns which are well illustrated in most papers on the subject. The malignant characteristics versus the benign characteristics of these cells are matters of debate, but in most instances the unfavorable feature of extreme cellularity is well balanced by the favorable features of cellular differentiation and the infrequent occurrence of mitosis. The appearance of the endometrium usually is that which would be expected during the estrogenic phase of the menstrual cycle, with straight glands and occasional cysts. In a few cases in which luteinization of the ovarian tumor cells seems to have occurred the condition of the endometrium is that brought about by progesterone stimulation. These circumstances suggest that some of these neoplasms produce two hormones. Concomitant carcinoma of the uterus is seen with 20 per cent of granulosa cell tumors. It generally occurs in the fundus of the uterus and is of the adenocarcinomatous type, with good differentiation and little tendency toward infiltration. It has been estimated that the association of uterine carcinoma with granulosa cell tumor exceeds by more than 100 times the incidence that would be expected were the coexistence a chance one. The implication that estrogen acted in these cases as the carcinogenic agent is more than fanciful. It should exert a sobering influence on modern endocrinologists who believe in treating "menopausal symptoms" with large doses of synthetic estrogens.

Treatment and Prognosis—A granulosa cell tumor does not often recur or metastasize. When recurrence and metastasis do take place they nearly always develop in connection with poorly encapsulated primary tumors and in older persons. Consequently, the use of conservatism in the treatment of patients in the younger age groups and the employment of more radical procedures for older patients seems to be logical. Pregnancy sometimes has occurred after the removal of granulosa cell tumors from younger patients. The possibility that the condition of older patients who have granulosa cell tumors may be

ARRHENOBLASTOMA

Definition—Arrhenoblastoma is an ovarian tumor, often defeminizing and masculinizing. Histologically, it exhibits somewhere in its architecture a composition suggestive of testicular elements.

Histogenesis—The embryologic development of the gonads is complex, and many women have, within the hilus of each ovary, tubular structures which are considered by some investigators to be potentially, if not actually, testicular. Meyer and other workers believe that the arrhenoblastoma is derived from these male-directed elements. A related theory holds that neoplasia of an ovotestis occurs, and this theory has its proponents. Recent investigators like Hartz have emphasized the frequent finding, in these tumors, of entodermal and other derivatives, and this finding has brought some support to the notion of the teratomatous origin of the arrhenoblastoma, with testicular overgrowth. It is, however, possible that the histogenesis of arrhenoblastoma may have several avenues.

Incidence—Arrhenoblastoma is of rare occurrence. The number of cases reported in the literature is somewhere between seventy five and 100.

Age—Women suffering from the effects of arrhenoblastoma usually are of childbearing age, but a few of the tumors have been described as occurring in older women.

Symptoms—A woman afflicted by an arrhenoblastoma may complain of symptoms ranging all the way from those caused merely by the mechanical effects of a pelvic tumor to those associated with severe masculinizing effects. When arrhenoblastomatosis is advanced there are amenorrhea with sterility, a masculine type of hairiness, atrophy of the breasts, hypertrophy of the clitoris and disturbing changes in the voice. Symptoms may manifest themselves rather suddenly or it may be months and even several years before they appear fully developed. Since, as I have already pointed out, an arrhenoblastoma is of rather infrequent occurrence the foregoing symptoms may be caused by some condition other than arrhenoblastomatosis. Even so,

of the present paper

Results of Studies of Hormones—Values for estrogens in the urine usually are low or absent in cases of arrhenoblastoma. The clinical sterility and the observed atrophy of the uninvolved ovary suggest lack of follicle stimulating hormones. Various androgens have been put of
these
action

between the adrenal masculinizing syndrome and the ovarian masculinizing syndrome

Gross Surgical and Microscopic Observations—An arrhenoblastoma usually is solid, encapsulated, and of moderate size. The cut surface is grayish. Multicentric lobulation is rather outstanding. The uterus is small.

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Resemblance of these tubules to the straight tubules of the testis is strong. In some tumors will be seen here and there interstitial cells laden with refractile fatty deposits. When an arrhenoblastoma exhibits this tubular adenomatous type of tissue the diagnosis is easy to make, but other arrhenoblastomas may be composed of small, dark-staining, round to spindle cells and may mimic a granulosa-cell tumor. In the diagnosis of such neoplasms clinical and pathologic observations must be correlated. Definite teratomatous characteristics may be evident.

Treatment—In most cases removal of the arrhenoblastoma results in regression of most of the masculinizing features. Pregnancy becomes possible. Clinically, however, an arrhenoblastoma sometimes is malignant, with recurrence and metastasis taking place early or after a period of five or even ten years. Consequently, for older persons and persons in whom infiltration occurs beyond the capsule of the tumor the additional sacrifice of the uterus, the tubes and the uninvolved ovary is justifiable.

MASCUINOVBLASTOMA (ADRENAL-LIKE OVARIAN TUMOR)

Definition—A masculinovoblastoma is a primary ovarian neoplasm which has the pathologic features of a carcinoma of the adrenal cortex. Usually, a masculinovoblastoma produces the clinical features of Cushing's syndrome.

Histogenesis—In certain adrenalectomized animals the ovaries can, in part, assume the microscopic features and the physiologic function of adrenal cortical tissue. It is known also that, embryologically, adrenal and ovarian cortical tissues develop in close proximity. Consequently, the origin of the masculinovoblastoma theoretically could occur by way of adrenal rests or as a result of metaplasia of ovarian cortical cells. A teratomatous derivation of masculinovoblastoma is possible, but is not thus far proved.

Incidence—Masculinovoblastoma is of rare occurrence. Less than twenty authenticated instances of this tumor have been reported in the literature. Many masculinovoblastomas reported earlier have been proved to be, on recent analysis, instances of metastatic hypernephroma and of luteinized granulosa-cell tumors.

Age—Masculinovoblastoma tends to affect women during the period of fertility.

Clinical Features—The sort of masculinization which accompanies arrhenoblastoma also characterizes masculinovoblastoma, and to this symptom must be added, in most cases, the several other features which characterize Cushing's syndrome. Thus, plethoric obesity, hypertension, diabetes and polycythemia often are present. In most instances this combination of observations has a basis in adrenal cortical tumor or hyperplasia. In the cases under discussion, however, palpation of an ovarian mass will sometimes exclude the adrenal cortical lesion and lead to the correct diagnosis.

Results of Studies of Hormones—Results of studies of hormones have been at variance with each other. At present, estimations of certain 17-ketosteroid fractions in urine seem to hold some promise for assistance in matters of differential diagnosis.

Gross Surgical Observations—Masculinovoblastomas are unilateral, generally encapsulated and of moderate size. The cut surface discloses a friable, distinctly yellow tissue. Zones of necrosis and hemorrhage frequently are seen. Local extension and distant metastasis are some of the unusual features.

Microscopic Features—Large, clear polygonal cells grouped in a trabecular or pseudo alveolar manner are suggestive of the architecture of the adrenal cortex. Cellular pleomorphism with mitotic figures, characterizes the more malignant masculinovoblastomas. The presence of both fat and glycogen heighten the similarity to adrenal cortical tissue, as do also positive results of staining according to the ponceau fuchsin technic. It must be remembered, however, that from the microscopic standpoint alone it may be impossible to distinguish the tumor in question from metastatic hypernephroma and luteinized granulosa-cell tumor.

It occurs after the menopause, hysterectomy as well as bilateral salpingo oophorectomy is indicated.

THE RESIDUAL GROUP

In this section strumal tumors and Brenner tumors of the ovary

actually may exert a "function" thyroxin is by no means native to the ovary. On careful search it will be found that about 20 per cent of ovarian teratomas contain thyroid tissue. In 120 cases reported in the literature, thyroid tissue overgrew the other elements to such an extent that the teratomas were called "strumal" or "thyroid" tumors. In thirty cases it was discovered that even the teratomatous nature of the

lesion, although it was accepted, could not be proved microscopically, since no other tissue types were identified. From the standpoint of functioning, clinical evidence of thyrotoxicosis, which sometimes leads to the performance of unnecessary operations on the thyroid gland is encountered in 5 per cent of cases of strumal tumors. Carcinoma likewise has an incidence of about 5 per cent in tumors of this type, in one instance reported by Emge there was fair evidence that the malignant thyroid cells elaborated a thyrotoxic substance.

Pathologically, the tumors resemble nodular goiters. Ascites is a frequent accompaniment. Tall hyperplastic thyroid epithelium and thin colloid can be found microscopically in "nontoxic" as well as "toxic" members of this group.

Brenner Tumor—Brenner tumor occasionally has been said to produce menorrhagia, but perhaps the most acceptable "excuse" for inclusion of the tumor in the present paper is the fact that it may be confused with granulosa-cell tumor. As regards the origin of Brenner tumor, results of histogenetic studies of approximately 200 reported examples thus far have not progressed beyond the stage of speculation. A Brenner tumor may arise from müllerian rests and be the counterpart of metaplastic cervical epithelium. It may be of wolffian origin, even though certain wolffian tumors of the neck of the bladder in no way resemble this ovarian enigma. A teratomatous origin may be possible because Brenner tumors are found in the walls of mucinous cysts, which are regarded by many as being teratomas. Meyer's original concept of the derivation of Brenner tumor from Walthard cell rests of squamous epithelium is still accepted by many workers.

At surgical exploration Brenner tumors are seen to vary greatly in size. They may be solid or cystic. They are encapsulated. The lesion with which Brenner tumor is most likely to be confused is fibroma, but since both tumors are benign, serious mistakes in treatment are not likely to result from nonrecognition of type. In certain cases Brenner tumor is discovered accidentally because it appears in the form of thickened nodules in the walls of mucinous cysts.

The histologic appearance of Brenner tumor is that of isolated nests of large, sharply demarcated, squamous like cells with central transition to columnar elements. These elements produce mucus. They are arranged around cystic spaces. About 90 per cent of the tumor is composed of fibrous tissue. A diagnosis of metastatic epidermoid carcinoma can be ruled out by the absence of pearly bodies, mitotic figures and cellular anaplasia. The large size of the cells, the presence of mucus and the unusual amount of fibrous component distinguish Brenner tumor from granulosa-cell tumor.

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LEUKORRHEA: ITS CAUSES AND TREATMENT

SIM B. LOVELADY

ABNORMAL nonsanguineous vaginal discharge is one of the most common gynecologic complaints and yet in general it probably is treated more inadequately than any other disorder of the female genital tract. The common term for this type of abnormal vaginal discharge is leukorrhea.

It is sometimes difficult to distinguish between normal and abnormal vaginal discharges since the female genital tract is under hormonal influence and therefore subject to many variations. Patients not infrequently consult their physicians because of a mild vaginal discharge for which no specific cause can be found, but close questioning of the patient reveals that the condition has definite cyclic variations. These variations suggest that the discharge probably is normal for that particular patient. Psychic stimulation also should be kept in mind as a possible exciting factor. The excess discharge of early pregnancy which may begin so abruptly and be so profuse as to suggest acute gonorrhea is best explained on a hormonal basis. It is not wise, of course, to reassure any patient that her complaint is physiologic until a conscientious attempt has been made to find some pathologic process.

The scope of this paper does not permit a detailed resumé of all the possible causes of leukorrhea, but an effort has been made to describe the more common conditions with which the specialist and general practitioner have to deal.

Examination of every woman who comes to the physician concerning an abnormal vaginal discharge should follow a well-organized plan. The first step and one of the most important, is the taking of an accurate history. In the taking of the history it is not uncommon, by careful questioning, to obtain important information concerning such

the possibility that senile or atrophic vaginitis is present. A history of exposure to gonorrhea, as well as the associated urinary symptoms of frequency and burning, is obviously significant.

Physical examination should be thorough and should include general examination with special attention to the pelvis. It should be kept in mind that leukorrhea can be caused by many debilitating diseases. Careful inspection of the discharge frequently suggests the diagnosis. The examiner should be familiar with the appearance of normal vaginal mucosa because rather often if vaginitis is present the type becomes obvious as soon as the speculum has been introduced. For example the petechia like spots on the vaginal mucous membrane especially in the anterior fornix and over the cervix in trichomoniasis are different from the small pin point areas that bleed when a fleck of yeast bearing discharge is wiped away. Examination of the cervix should be made with adequate exposure and light. In women a bimanual examination is essential to rule out the possibility that a palpable pathologic lesion of the genital tract is present. It takes only a few minutes to make the examination complete by taking material for wet mounts, smears and cultures from the suspected sources of infection.

CHRONIC CERVICITIS

Many women tolerate profuse leukorrhea and severe infection of the cervix for many years before consulting their physicians. Trauma of the cervix during labor and the presence of many micro organisms in the vagina provide an ideal condition for infection. The organisms which most frequently cause cervicitis are the streptococcus, staphylococcus, *Neisseria gonorrhoeae* and *Escherichia coli*. Leukorrhea is the most common symptom of cervicitis. Edema of the cervix which interferes with the blood supply and the normal muscular motility of this organ may help to cause faulty involution of the uterus and give rise to menstrual disturbances. Backache is present in a large percentage of cases of cervicitis. Under certain conditions the cervix may be considered a possible focus of infection as in iritis and such diseases. Spotting after douches and intercourse and sterility are rather common complaints associated with this condition. Before treating any patient who has chronic cervicitis and erosion it is well to perform a biopsy to rule out the presence of an early epithelioma of the cervix.

Erosion, eversion, ectropion and nabothian cysts may develop after infection of a laceration of the cervix. While many physicians think that erosion is the result of infection, some think that a hormonal factor is present. The cervix appears fiery red, often bleeds easily and may present a somewhat granular appearance. The cervix of a young girl or a virginal woman is fairly normal in size, while a cervix which becomes infected after delivery may be several times normal size and may contain many nabothian cysts. The eroded surface may be partially covered by columnar epithelium, the remainder being devoid of epithelium. At the Mayo Clinic we have made a practice in all cases

erosion of performing preliminary biopsy and cautery in the office. Our results have been uniformly good. This procedure causes the least little discomfort. If she seems unusually nervous, we do not hesitate to give $1\frac{1}{2}$ grains (0.1 gm) of nembutal about thirty minutes prior to treatment. The discomfort may be alleviated further by applying a 10 per cent solution of cocaine to the part to be cauterized in the cervical canal. The patient is observed for from ten to twelve days because occasionally considerable bleeding will occur when the slough separates. Follow-up treatment consists of local application of some antiseptic solution or, recently, application of one of sulfonamide vaginal creams daily after cautery. Some think that follow up treatment aids separation of the slough, but one of the important things is that it cuts down on the odor and discomfort of the discharge. When the patient is dismissed, she is instructed to take a vinegar douche daily for about a month, using 3 to 4 table spoons (about 15 cc) of vinegar to a quart of water. If after this time the cervix has not healed completely, further cautery may be attempted.

Eversion of the cervix is an outpouching of the overgrowth of tissue which has piled up in the cervical canal. Eversion is seen more commonly in cases in which the cervix was torn during childbirth or instrumental delivery. As the result of the tear the cylindrical epithelium of the canal becomes exposed and is more susceptible to bacterial infection. Ectropion of the cervix is an exaggerated eversion. For treatment of the milder forms such as are seen frequently at the time of pelvic examination, some authors have recommended use of silver nitrate and reported good results. It has been our practice either to use cautery in the office or to recommend that these patients take regular douches and that they return for examination in one month. Sometimes it is surprising how much healing will take place as the result of only one or two douches a day.

Electrocoagulation has given excellent results in treatment of chronic cervicitis with erosion and also has the advantage that it can be performed in the office and anesthesia is not necessary. It does not seem to hinder dilatation of the cervix in subsequent labor. Of all the methods available for the treatment of cervical erosion light cautery or electrocoagulation would seem best for those patients who wish to remain pregnant and do not have enough laceration to warrant hysterectomy. With early and persistent treatment of cervicitis in the office, the physician not only can prevent more severe cervicitis but can save the patient considerable expense, and early treatment of cervicitis is thought to be prophylaxis against carcinoma of the cervix. More than half of the patients who have chronic cervicitis are treated adequately by means of office procedures.

The more severe grades of cervicitis require some type of surgical treatment, such as deep cautery, trachelorrhaphy, conization or amputation. General anesthesia is used. For treatment of the large hypertrophied cystic cervix with and without associated erosion in cases in which the patient desires further pregnancy, we employ the deep puncture type of cautery carrying the cautery tip up to the level of the internal os, but preserving the endocervix and thus we think, preventing stenosis. Usually six or seven such punctures are made around the external os and the large underlying cysts are destroyed. This requires hospitalization for five to seven days and the slough usually does not separate for from two to three weeks during which time the patient should curtail her activity because of the possibility of hemorrhage. Healing frequently is not complete for from three to six months after which time the appearance of the cervix will often so approach normal that it is unbelievable.

In the case in which erosion or eversion of the cervix seems too extensive for cautery in the office we prefer to use a medium deep stellate type of cautery and results have been fairly satisfactory.

Conization is an excellent procedure and is a rapid and easy method of accomplishing amputation with much less loss of blood than occurs during the Sturmdorf amputation. The Crossen Brown electrode is preferable and there should be as little coagulation of tissue as possible. Conization should be performed only in those cases in which the patient is past the childbearing age and those in which childbearing is not a factor.

Trachelorrhaphy is a valuable procedure and should be used in treatment of the young patient whose cervix is lacerated enough to interfere with carrying a pregnancy to term, provided pregnancy is desired by the patient. If pregnancy is not desired or if the patient is more than forty years old we are of the opinion that in most instances high amputation of the cervix is desirable. Patients who undergo trachelorrhaphy are hospitalized for ten days on the average and in our experience complications such as hemorrhage, stenosis and flare up of pelvic inflammatory disease are less likely to occur than when cauterization is used in these cases. In addition the end results are better and more sure and the specimen can be examined carefully microscopically. We do not feel that surgical treatment should be used in the face of active infection of the upper part of the genital tract.

Occasionally in a case in which the cervix is badly diseased and subinvolution of the uterus has occurred it has been our experience that nothing short of total hysterectomy will permit subsidence of the associated parametritis. Hysterectomy in these cases usually is done by means of the vaginal approach.

CERVICAL POLYPS

Cervical polyps not infrequently cause leukorrhea although slight bleeding usually occurs. These polyps are usually and protrude from the cervical os. Such growths can be removed easily in the office by torsion and light cautery to the base. A men always should be sectioned and examined under the microscope for evidence of malignant changes.

TRICHOMONIASIS

The presence of *Trichomonas vaginalis* may be suspected in which women relate that they have had an irritating discharge which seems more profuse before and after their menstrual periods. The presence of these organisms in the vagina may not produce symptoms, but in most instances gives rise to a profuse, slightly discolored discharge, which causes the patient to consult her physician. Trichomonads are easier to find on the first examination before or after lubricants have been introduced into the vagina. The diagnosis by means of a fresh smear is as accurate as diagnosis by the use of the cultural methods and is so much simpler. A drop of physiological saline solution is placed on a slide and the tip of the examining finger is touched to the saline, a coverglass is placed over the preparation and the slide is examined with a microscope. The trichomonads can be seen and identified by their motility with the low power objective providing the mount is not too thick. On closer examination with high power lens, the pear shaped organism with its flagella can be studied in more detail.

There is still much controversy as to the pathogenicity of the trichomonads. The scope of this paper does not permit a discussion of the different views on the subject but it is known that the presence of trichomonads can cause leukorrhea and that eradication of the organisms gives prompt relief from this symptom. Aside from the fact that trichomonads are known to infect the mouth, the intestinal tract in men, the prostate and the seminal vesicles. These known facts should be borne in mind in treatment of persistent infections of the type which in most instances probably are reinfections.

Most treatment of this condition is aimed toward creating conditions in the vagina which favor the development of a normal vaginal flora and which permit or stimulate normal epithelial growths. A combination of both. Many forms of treatment in use today would doubt give better results if carried out in a systematic manner. The use of vinegar douches alone will effect a cure in many cases of trichomonas vaginitis. Acetarson (stovarsol) with salicylic acid, zinc oxide or diodoquin and lactose, dextrose and boric acid used in powder form have become widely used with satisfactory results. The powder is blown into the vagina with a type of air gun. This

cedure is best accomplished when the patient is in the knee chest position since the ballooning of the vagina flattens out the rugae. However, this position is awkward and embarrassing for the patient and for this reason is not always employed. Treatments should be given daily for about six or seven days allowing the powder to accumulate in the vagina. At the end of this time the powder may be removed with the finger and the patient may be instructed to take a vinegar douche every other day for from two to four weeks.

Some physicians prefer to have the patient use one of the more commonly known vaginal suppositories two or three times a week for three or four weeks after the powder treatments to the vagina. Since the infection is more likely to recur after menstrual periods it is well to instruct the patient to use either vinegar douches or vaginal suppositories at that time.

For some time now, we have used some of the sulfonamide vaginal creams and jellies in treatment of vaginitis and cervicitis due to *Trichomonas vaginalis* with excellent results. These medications can be applied by the patient and have a tendency to keep down the disagreeable odor that accompanies these conditions. We have found also that after crutery to the cervix has been carried out in the office these sulf

We have limited treatment in the cervix without the presence of trichomonads.¹ The results thus far in this group of cases have been promising. The patient is usually symptom free in from one to two days and in the small group that we have treated the trichomonads have not been present in the vaginal smears forty eight to seventy two hours after treatment was started. Siegler recently reported good results of treatment of vaginitis and cervicitis with sulfathiazole jelly. Rock, Barker and Bacon reported that they had treated a small group of patients who had vaginitis and chronic cervicitis with penicillin vaginal suppositories. Of course these newer forms of treatment will have to be observed for a considerable period before any definite conclusions can be drawn as to their therapeutic value.

MONILIAL OR FUNGOUS VAGINITIS

A monilial infection in the vagina gives rise to a curdy type of discharge. The vaginal wall and cervix usually appear red with small flecklike patches over the surface which bleed when rubbed off. Besides the uncomfortable irritation which accompanies this condition pruritus about the vulva and anus frequently is associated. This type of vaginitis commonly occurs during pregnancy.

When a small bit of the curdy material is placed on a slide in a drop

* These suppositories were supplied through the courtesy of Schenley Laboratories Inc. Lawrenceburg, Indiana.

of solution of sodium hydroxide under a coverglass the monilia buds and rods frequently can be seen with the microscope. The best means of identification is by cultural methods.

These yeast organisms are readily destroyed by gentian violet (a 2 per cent solution of gentian violet alone or in combination with acriflavine hydrochloride and glycenn). Three treatments with gentian violet usually are sufficient. Use of gentian violet tampons is under investigation and may prove of great value as follow up treatment in cases in which the infection is more persistent.

SENILE OR ATROPHIC VAGINITIS

Senile vaginitis generally is encountered in cases in which the patient has passed the menopause or has been deprived of the influence of the ovaries.

On inspection the examiner frequently notices atrophic changes about the vulva. The vagina appears red with small punctate red or yellowish areas which bleed easily on slight trauma with the speculum or examining finger. Many observers frequently have found monilial and trichomonal infections associated with this type of vaginitis.

The thickness of the vaginal mucous membrane is much less than normal and there is desquamation and decreased cornification of the surface epithelium. Vaginal smears reveal many leukocytes and a few erythrocytes, considerable debris and epithelial cells.

Many forms of treatment for this type of vaginitis have been directed toward changing the pH of the vaginal secretions and encouraging growth of normal bacterial flora. Some authors have advocated use of a combination of beta lactose and citric acid to the vaginal mucous membrane. We have used beta lactose alone and found that most of the patients received prompt symptomatic relief. Some observers have reported good results of administering vitamin A in the form of cod liver oil or haliver oil and of giving a diet rich in milk, eggs, fresh meat, fruits and vegetables.

An attempt should first be made to clear up any monilia or trichomonads that might be present. The senile type of vaginitis responds promptly to treatment with estrogenic substances which may be administered with effectiveness by means of vaginal suppositories. Progynon vaginal suppositories are available which contain 480 and 4,800 rat units. Estrone vaginal suppositories contain 2,000 international units of estrogenic substances. Diethylstilbestrol vaginal suppositories (0.1 mg and 0.5 mg) are rather satisfactory but have to be used with caution. We usually employ the 0.1 mg size of diethyl-

The patient should be instructed to insert a suppository in the vagina two or three times a week for about a month and then gradually use them less often as the vaginitis improves.

In the treatment of senile vaginitis we have given estrogenic substances orally alone or in conjunction with the estrogenic suppositories. If using diethylstilbestrol we prefer to use 0.1 mg daily until the symptoms subside.

GNORRHEA

Presence of gonorrhea may be suspected when there is sudden onset of profuse leukorrhea with the associated urinary symptoms of frequency and burning. The diagnosis usually can be confirmed by means of a well made smear for which Grams stain is used; however if a laboratory is available cultural methods give more accurate results. In adults gonorrheal vaginitis is only transitory and not a significant part of a clinical picture. Therefore material for smear or culture should be taken from the urethra and cervix. Treatment should consist of keeping the patient at rest in bed, local cleanliness and administration of penicillin in adequate doses to maintain a constant therapeutic level in the blood. We have used penicillin in beeswax for treatment of several of these patients without hospitalizing them. Results in these few cases have been excellent.

Results of treatment of gonorrheal vaginitis in children with sulfanilamide have not been too promising but results with estrogenic vaginal suppositories have been good. We do not have occasion to treat many such patients. Small vaginal suppositories containing 2,000 international units of estrone can be obtained. The mother should be instructed to insert one suppository into the child's vagina each night for two to three weeks and then the dosage should be reduced and treatment should be continued for about another three weeks. Large doses should not be used. If the temperament of the child prevents this type of administration the appropriate one of the synthetic estrogenic preparations may be given by mouth and may prove valuable. Penicillin vaginal suppositories should be of great value in treatment of gonorrheal vaginitis in children. To date we have not had the opportunity to use them.

SUMMARY

The more common causes of leukorrhea are chronic cervicitis, vaginitis, and the presence of foreign bodies. The majority of instances to bring about a cure or produce marked improvement of the condition.

Use of the newer preparations such as penicillin vaginal sup-

positories, sulfathiazole applicators and sulfathiazole creams, has given excellent results in some cases of leukorrhea

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MANAGEMENT OF URINARY INCONTINENCE IN WOMEN

DEWARD O FERRIS

A GREAT deal has been written about incontinence of urine in women and many and varied have been the operative procedures designed to relieve it. It is a common and distressing condition. It may be either congenital or acquired, the latter being by far the commoner. In recent years much has been learned regarding the cause and treatment of acquired incontinence and this discussion will be confined to that type.

ETIOLOGY

Acquired urinary incontinence usually is a result of childbirth or other direct trauma. Taylor and Watt, who reviewed the records of 1,005 gynecologic cases in a hospital, found incontinence in 15 per cent.



Fig. 289.—Female urethral constriction located behind symphysis and embedded in anterior vaginal wall (From Counseller V. S. Urinary incontinence among women. *Am. J. Obst. & Gynec.* 45.)

The incontinence varies from moderate to severe and depends entirely on the amount of damage caused by trauma. It is not always

associated with cystocele, prolapse of the vaginal vault or prolapse of the uterus. In fact, some patients with complete procidentia have no urinary incontinence and some who have severe incontinence have no associated cystocele. Occurrence of incontinence depends on displacement of the upper part of the urethra that is, that part which is held in position by the urogenital diaphragm and is surrounded by the sphincter urethrae membranaceae. As long as this muscle remains intact the control is good but when it is torn a sagging of the upper part of the urethra occurs with any stress, and control is lost.

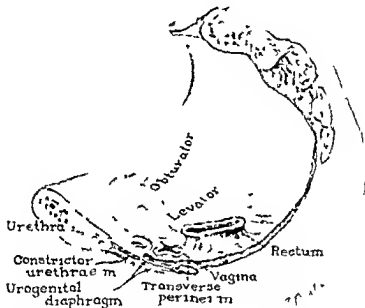


Fig. 290—Relation of the muscles to the urethra and urogenital diaphragm (sagittal section). (From Counseller & S. Urinary incontinence among women. *Am. J. Obst. & Gynec.* 45)

from the anterior vaginal wall tearing or this musculofascial sheet allows a herniation of the bladder to occur a cystocele. The bladder and ureters lie loosely on the vaginal wall while the urethra lies in intimate contact with the anterior vaginal vault (fig. 289). The urogenital diaphragm is perforated anteriorly by the urethra, and the part of the urethra lying between the two layers of the urogenital

diaphragm is surrounded by a striated muscle, the sphincter urethrae membranaceae (fig 290) This sphincter is under voluntary control In its position between the two layers of the urogenital diaphragm it covers the middle and posterior thirds of the urethra (fig 291) Its external fibers arise from the junction of inferior rami of the pubis and ischium and from the neighboring fasciae Another group of fibers the sling group, arises in the angle beneath the symphysis pubis (fig 292) These fibers pass downward and medially on each side of the urethra to interdigitate across the midline with the fibers from the opposite side Both the external fibers of the sphincter urethrae membranaceae and those of the sling group terminate in the interior vaginal wall to which they are firmly attached

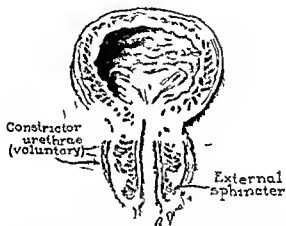


Fig 291—Musculature of the urethra. (From Counseller V S Urinary Incontinence among women Am J Obst & Gynec 45)

The anterior group of fibers is well protected and is rarely torn The posterior and sling groups of fibers which lie between the urethra and the vaginal wall are easily torn It is easily seen then how severe or prolonged pressure by the advancing head during childbirth can cause tearing of the fibrous attachment to the vaginal wall and damage to the fibers which interdigitate across the midline The torso muscles retract and the resultant space becomes filled in by scar tissue Consequently the efficiency of the voluntary sphincter is weakened

The two other sphincters of the urethra the internal and external sphincters are composed of smooth muscle and are involuntary in action

While the levator ani deep perineal and bulbocavernosus muscles can hardly be called "true sphincters" they are nevertheless often

referred to as "accessory sphincter muscles" and may be thought of as having accessory sphincter control. However, I am convinced that impaired function of the sphincter urethrae membranaceae is the important factor in urinary incontinence.

The first concrete evidence of the function of the sphincter urethrae membranaceae as a voluntary sphincter was demonstrated by Kennedy in 1937. He studied first the normal urethral mechanism with the aid of roentgenograms made after a simple rubber sac had been

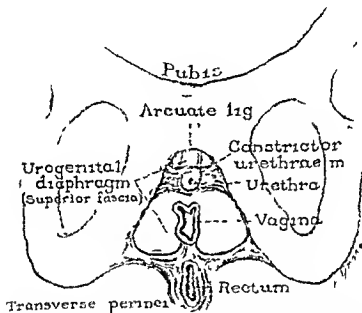


Fig. 292—Diagrammatic view of constrictor urethrae muscle and urogenital diaphragm. (From Counsellor V. S. Urinary incontinence among women. *Am J Obst & Gynec* 45.)

placed in the urethra and connected to a manometer in which the roentgenopaque fluid was a solution of sodium iodide. Pressure could be measured at the time pictures were taken. With this method while a roentgenogram is being taken the patient is asked to "hold," to "relax" or to "void" as the case may be. The information ascertained by this type of investigation is that while there is an involuntary sphincter about the inner third and another about the outer third of the urethra, there is an additional sphincter about the middle third which is under voluntary control and which is stronger than either

involuntary muscle This method of study was then used as a diagnostic procedure in the examination of women who had incontinence and in most cases the relative weakness was found to be at the site of the voluntary sphincter

That the internal involuntary sphincter is not of much importance is demonstrated by the lack of incontinence after transurethral resection of the vesical neck in women

Kennedy has stressed the importance of the method of injury to the sphincter mechanism that occurs during childbirth and rightly so This trauma may cause damage to the voluntary sphincter as described or it may cause other damage which contributes to incontinence Should the damage be between the urethra and the pubic ramus healing may leave connective tissue which permanently distorts the urethra The urethra in such cases Kennedy found assumes a degree of a permanent state of voiding The distortion interferes with the freedom of action of the internal involuntary sphincter

TREATMENT

The treatment is surgical correction with the surgeon keeping the following factors in mind The sphincter mechanism functions with greatest efficiency when its greatest length is restored when it is restored as far as possible within the pelvis and when it is restored as high as possible within the vagina Function of the sphincter mechanism will remain hampered if the urethra is not completely separated from the vaginal wall and pubic ramus After the urethra has been completely freed restoration of the sphincter mechanism can be satisfactorily accomplished by plicating and replicating the undersurface of the bladder and urethra The sphincter mechanism unhampered by any lateral tractive process after restoration will perform its normal function

Technic—The actual technic which I follow in these cases is this The cervix is grasped with a tenaculum and the anterior vaginal wall is opened in the usual manner to a point 1 to 2 cm from the external urethral meatus (fig 293) The urethra is separated from the pubic ramus on each side This separation must be kept close to the bone to avoid injury to a plexus of veins and to branches of the inferior vesical artery and must extend into the paravesical space If this is done carefully and accurately one can be sure of freeing the urethra in so far as adhesions are concerned This freedom of motion of the urethra must then be maintained This is accomplished by plicating the tissues under the urethra by mattress sutures which hold the urethra away from the pubic ramus (fig 294) A second row of mattress sutures picks up the edges of a fascial like structure on the lateral surface of the urethra (fig 295) This row of sutures gives additional support and further separates the urethra from the pubic ramus The

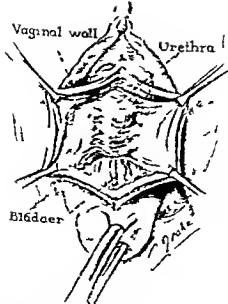
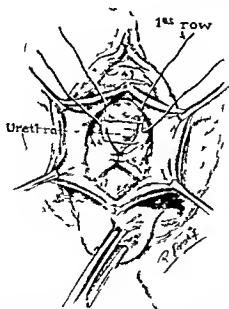


Fig 293—Anterior vaginal wall opened to a point 1.5 cm. from external urethral meatus (From Counsellor \ S Urinary incontinence among women. Am J Obst & Gynec 42)



294—First row of mattress sutures plicating tissues under urethra. (From Counsellor \ S Urinary incontinence among women. Am J Obst & Gynec 45)

suture overlying the vesical neck that is the one near the internal urethral meatus is really the Kelly stitch and helps to reinforce or support the internal sphincter

The next step is restoration of the voluntary sphincter. The damaged portion of this muscle which remained attached to the vaginal wall is removed along with the redundant portion of the vaginal wall. The remaining intact sphincter fibers are brought together in the midline. This is accomplished by placing interrupted sutures through the vaginal wall on each side quite close to the pubic rami in order to

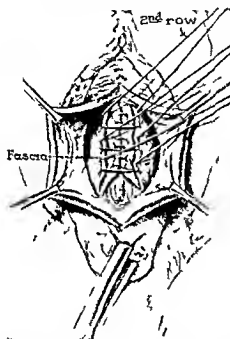


Fig 295 Further separation of urethra from pubic rami by second row of mattress sutures (From Counsellor V S Urinary incontinence among women Am J Obst & Gynec 45)

pick up the fibers of the voluntary sphincter and inferior layer of the urogenital diaphragm (fig 296) and tying them in the midline. When these are all tied the edges are found to lie beneath the inner and middle portion of the urethra. Kennedy uses silver wire in his operation but I use catgut throughout. Counsellor in his series used catgut entirely.

A simple catheter is placed in the urethra for the first seven to ten days after which it is removed and the patient is allowed out of bed. If the patient cannot empty the bladder normally the urethral catheter

is reinserted and left for three to five more days at which time almost all patients empty the bladder without difficulty. A mild cystitis may occur but it is easily corrected by chemotherapy.

Results—With this type of operation the results are gratifying. Kennedy reported twenty-six cures in twenty-eight cases in which operation was performed. Counseller reported complete restoration of continence in every case of his series of twenty-six cases.

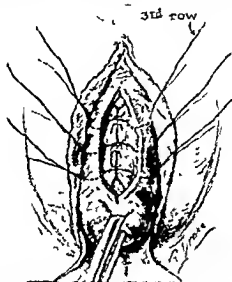


Fig 296—Reconstruction of constrictor urethrae muscle and urogenital diaphragm beneath the urethra (From Counsellor V S Urinary incontinence among women Am J Obst & Gynec 45)

SUMMARY

The female urethra has an internal and an external involuntary sphincter. In addition there is a voluntary sphincter the normal function of which is necessary for urinary continence. The trauma of labor

tary sphincter is impaired as a result of splitting of its fibers along the urethra in or adjacent to the median raphe. Of secondary importance is the trauma to the internal involuntary sphincter; this trauma, directly or indirectly, causes these sphincters to be distorted and fixed to the ramus of the pubis. Kennedy has suggested a method of repair which has greatly improved his results, and these have been duplicated by Counsellor.

It is now clear that the sphincter mechanism of the female urethra is more delicate and complicated than it previously was considered to be. Incontinence was thought to be the result of damage to the internal urethral sphincter. This may be true in certain instances of mild incontinence but in most cases the damage extends beyond this sphincter and involves the voluntary sphincter.

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MEDICAL VERSUS SURGICAL TREATMENT OF PELVIC INFLAMMATORY DISEASE

ROBERT B. WILSON

GENERAL CONSIDERATIONS

From this title it might appear that the treatment of pelvic inflammatory disease both are employed either singly or in combination. Experience constantly emphasizes that the two methods of treatment are complementary. However with the availability of sulfonamides, antibiotic substances and improved methods of heating the pelvis by diathermy, it has become evident that more and more patients can be effectively managed with medical treatment alone.

Certain aspects of the treatment of this condition have become so well established that they hardly deserve repetition. In the acute case surgical treatment is rarely employed, since it is necessary to allow the acute inflammatory process to subside before operation can safely be performed. Occasionally it is necessary to effect cul de sac drainage of an acute pelvic abscess through a colpotomy incision. Aside from this and with the previously mentioned methods for medical treatment one may emphasize that the need for surgical management is indeed extremely rare. Medical treatment is thus the treatment of choice.

that adhesions, involvement of the bowel and bladder, chronic symptoms referable to the intestinal or urinary tracts and persistent pain.

blood supply due to adherent retroversion or prolapsed adherent tubes and ovaries. Evidence of a mass is not due to active position adherence in destruction of ovarian

of ovarian dysfunction, such as vaginal bleeding which may be sufficient to require surgical intervention

Etiology.—Most attacks of pelvic inflammatory disease are caused by gonorrheal infection or by streptococcal or staphylococcal infection following abortion which has usually been induced, but which may have been spontaneous. More rarely this condition may follow parturition. Tuberculosis may involve the pelvic viscera. In this presentation, however, treatment of pelvic tuberculosis will not be considered, as the diagnosis is seldom made preoperatively and in usual practice the disease is comparatively uncommon. Pelvic cellulitis following either roentgen or radium therapy for malignant lesions of the pelvic viscera is not uncommon and is often severe.

Pathology.—The pathologic picture of pelvic infection varies with the cause and with the tissues involved. When *Neisseria gonorrhoeae* is the causative agent the acute inflammatory process involves the tubal mucosa primarily. There are the usual findings of an acute inflammatory process with the lumen of the tube being filled with purulent exudate. Commonly the fimbriated tubal extremity becomes occluded and the resultant pyosalpinx often eventually becomes a relatively quiescent hydrosalpinx. There is a varying amount of involvement of the surrounding structures. The ovary is not infrequently involved in an abscess. Adherence of the tubal serosa to any adjacent peritoneal surface is quite common, this adhesive process being the cause of much of the difficulty in the operative treatment in these cases.

In cases in which infection follows gestation the causative organism is usually some strain of streptococcus. In such infections the inflammatory process usually involves the mural portion of the tube, the tubal mucosa being relatively free of inflammatory changes. Invasion of the tissue in and about the pelvic organs commonly occurs. In such types of infection subsidence with minimal residual involvement is rather likely to occur so that surgical treatment is necessary infrequently. Tubal patency is more likely to be maintained after this type of infection than it is after gonorrheal salpingitis.

TREATMENT

The physician usually first sees a patient with pelvic inflammatory disease during the acute or subacute phase of the condition, the pain in the lower part of the abdomen, the fever and chills being of sufficient intensity to cause the patient to seek medical care. Before treatment is started a history may lead to a probable diagnosis as to the causative agent. Evidence of pregnancy or a history suggestive of venereal infection may be obtainable. A history of previous attacks of pelvic inflammatory disease is important, as the type of treatment used in chronic disease may vary from that for an initial attack.

Minimal laboratory procedures include a count of the erythrocytes and leukocytes differential count estimation of the value for hemoglobin determination of the sedimentation rate urinalysis and examination of cultures and stained smears from the urethra and cervix. The necessary general physical examination including examination of the pelvis must be made. It probably cannot be emphasized too strongly that the pelvic examination should be conducted as gently

categories (1) general and supportive measures (2) use of sulfonamides or antibiotic agents or both and (3) pelvic heating.

General and Supportive Measures—The need for general and supportive measures varies considerably with the severity of the disease. Some patients will have only mild pain and minimal evidence of disease on examination while others will have severe pain high fever abdominal distention perhaps ileus and a frozen pelvis all associated with dehydration and debility. Such patients require parental administration of adequate amounts of fluids sedation and rest in bed. Any aberrations of the chemical contents of the blood must be corrected in these severe cases.

Sulfonamides and Penicillin—Sulfonamides or penicillin should be administered to all patients who exhibit evidence of acute infection. At the Clinic treatment with penicillin generally is effective in nearly all cases of pelvic cellulitis. Penicillin is generally administered in doses of 30 000 to 40 000 units every three hours until the fever subsides and the clinical course indicates that the antibiotic substance is no longer necessary. Early treatment of both specific and nonspecific infections is most important; this is particularly true in gonorrheal urethritis and cervicitis. Before present day methods were available prolonged periods of rest in bed were necessary and even then the occurrence of ascending infection was not infrequent. Today in early stages of infection a dose of 300 000 units of penicillin in beeswax and oil is administered daily for three days. The patient may remain ambulatory but even so the incidence of acute salpingitis is relatively low after such treatment.

well known residua. Use of the conventional or so called long wave type of diathermy has been continued at the Clinic for several reasons

With this type of diathermy it is possible to observe the temperature of the vaginal electrode without shutting off the applicator. This is important, as one can then be certain that adequate heat is being delivered to the pelvis. It is thought that vaginal applicators for conventional diathermy are better than others. The Bierman-Horwitz vaginal applicator, molded from metal, is used; it has a flattened oval shape, with a depression for the cervix, and comes in three sizes. With this type of diathermy and electrode it is possible effectively to localize the heat at the desired sites. Actually it probably makes little difference whether short wave or so-called long wave diathermy is used so long as the procedure is carefully carried out. There are adequate and satisfactory electrodes for the short wave machine but, as already noted, it is difficult adequately to control the temperature with such machines.

Patients may be started on diathermy one or two days after admission and after treatment with sulfonamides or penicillin has been started. In very acute and severe cases it may be necessary to wait longer than a few days before diathermy can safely be started. Usually the first treatment is given by means of a short wave coil over the lower abdomen. If this is tolerated, intrapelvic or vaginal long wave therapy is started.

The only contraindication to pelvic diathermy is vaginal bleeding. In some instances profuse leukorrhea may interfere but usually a discharge is not considered a contraindication. Such a leukorrhea may be due to gonorrheal vaginitis and cervicitis, in this event it is cared for by the penicillin given. If the leukorrhea is due to a trichomonal infection, it should be treated by appropriate measures, if it is due to a moniliasis, it can usually be readily controlled by applying 1 per cent solution of gentian violet and 0.5 per cent solution of acriflavine in glycerin to the vagina, cervix and external genitalia. At first, but one diathermy treatment, which lasts for fifteen to thirty minutes, is given each day. The time is increased to forty-five to sixty minutes daily, if this amount of treatment is tolerated well, then two such treatments are given each day. If any of these treatments are not tolerated, as evidenced by the occurrence of fever or increase in pain, the time is shortened but usually treatment is not discontinued. Observation of the thermometer in the applicator permits maintenance of the temperature at 106° to 107° F, the rectal temperature will be found to be about 103° to 104° F. Twice daily, treatments are continued for two or three weeks or longer according to need as indicated by the clinical findings and by the results of pelvic examination. If improvement has been satisfactory but resolution is not complete, it is often wise to give the patient a rest from treatment for several weeks and then to administer another course of treatment with diathermy.

Consideration of Surgical Treatment—Only after trial of such a course of medical treatment as has been outlined should surgical treatment be considered. Often after such medical treatment the pelvis may be found to be completely free of disease. Even if there has been no real improvement in the physical findings the patient may be relatively free of symptoms; it is then possible to wait before surgical treatment is considered. The length of this waiting period varies a great deal with individual patients. In general observation of a long rather than a short interval before surgical intervention is considered is wise, as the longer the interval the more likely is the pelvis to be free of bacterial residua. Of course for the patient who has frequently recurring attacks of pelvic inflammatory disease and who has palpable evidence of considerable disease in the pelvis it is necessary to select what one considers an optimal time for operation. In general pelvic operation should not be attempted in the presence of fever or an elevated leukocyte count. The sedimentation rate may not have reached a normal value but should be appreciably lower than during the acute phase of the disease. A valuable clinical method of determining whether or not a patient can be safely operated on consists of performing a rather vigorous pelvic examination. If such an examination is followed by fever and other symptoms one has adequate evidence that the process is still in an active stage and that operation should be deferred. Obviously such an examination should not be done when other evidence of activity is present. Before operation it is important to improve the general condition of the patient as much as possible and to give penicillin preoperatively for three or four days.

In performance of operative procedures much difficulty may be encountered in the mobilization of the pelvic viscera; due care must be exercised to prevent injury to the bowel, bladder and ureters. If possible a young woman should be left with her reproductive function intact. In the woman past forty years of age little is gained by performing a conservative operation. It is debatable as to whether or not the uterus should be allowed to remain if the reproductive function is destroyed. As a rule surgical treatment is employed because of persistence of symptoms and the patient therefore expects to be relieved of them; accordingly treatment frequently must be radical.

stitution therapy Drainage through the abdominal wall or through the vagina is usually not employed by surgeons at the Clinic Often however, a cigaret drain or a drain made of a split rubber tube is placed in the wound down to the peritoneum

REPORT OF CASES

CASE 1—A woman was admitted to the Clinic on April 23 1937 She had been well until April 9 when she had begun to suffer from pain in the lower part of the abdomen chills and fever The temperature had varied from 100° to 103.6° F The patient stated that she had been married twenty eight years during that time she had had one pregnancy which had ended in spontaneous abortion She gave no history of a previous attack of pelvic inflammatory disease The pelvic examination revealed a large abscess which filled the entire lower part of the pelvis Laboratory data were as follows hemoglobin 12.9 gm per 100 cc of blood erythrocytes 3 240 000 and leukocytes 21 500 (85 per cent polymorphonuclear leukocytes) per cubic millimeter of blood result of Wassermann test negative results of cultures on chocolate blood agar and of examination of smears negative for gonococci sedimentation rate 58 mm in one hour on April 23 and 115 mm on April 28 Treatment with conventional diathermy was started on April 30 and given daily until May 17 The temperature returned to normal soon after diathermy was started The sedimentation rate on May 1 was 91 mm and on May 11 it was 24 mm in one hour The leukocyte count on May 11 was 5 800 per cubic millimeter A pelvic examination on May 14 revealed remarkable resolution of the pelvic abscess with only minimal residual thickening The patient subsequently was examined twice in 1937 and once in 1940 1942 and 1945 At each examination the pelvis was found to be completely clear

The case just reported is instructive because it illustrates what diathermy can do particularly if used early in the course of the disease This case has been used as an illustration because there has been adequate follow up and because diathermy was the only therapeutic agent used It may be significant that in this case the patient had but five or six menstrual periods after the treatment until spontaneous menopause occurred this may have been a factor in her complete recovery as the menstrual stimulus to a recurrence of the infection was not present

CASE 2—A woman thirty two years old was registered at the Clinic on October 5 1936 She had been married twelve years She stated that she had had an induced instrumental abortion performed in 1925 with no complications However eight months later she had suffered from symptoms indicative of acute pelvic inflammatory disease and was hospitalized for six weeks Four months after that another attack occurred and she was hospitalized for ten days At the time of her admission to the Clinic the patient complained of abdominal soreness which was not incapacitating and of constipation The pelvic examination revealed an adherent retroverted uterus and bilateral adnexal prolapse with adhesion Results of all laboratory tests including leukocyte count and sedimentation rate were within normal limits Cultures on chocolate blood agar gave negative results for gonococci The medical gynecologist who saw this patient stated that conditions in the pelvis were probably sufficiently pathologic to justify

operation The gynecologic surgeon thought that conservative operation was indicated and necessary Therefore on October 26 1936 the pelvis was explored and the following surgical procedures accomplished ventral suspension of an adherent retroverted uterus bilateral salpingectomy because of bilateral hydrosalpinx left oophorectomy because of hemorrhagic cystic oophoritis and appendectomy On the sixth postoperative day symptoms of obstruction of the small bowel developed and the pelvis was re-explored on the fourteenth postoperative day A loop of ileum was found adherent in the pelvis this was freed and a necrotic area in the bowel was excised Enterostomy was done Generalized peritonitis developed and the patient died sixteen days after the original operation

In all fairness it must be emphasized that this fatality occurred prior to the availability of the sulfonamides and the antibiotic agents. The

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the empirical treatment of pelvic inflam

Surgical treatment of pelvic inflammatory disease should not be undertaken lightly. This is true even though administration of the sulfonamides and antibiotic substances now available markedly lowers the mortality rate in generalized peritonitis. Adherence of a loop of small bowel to a raw surface in the pelvis with subsequent obstruction is not a rare occurrence. It can be prevented by adequate peritonization and if this is not possible by suture of the sigmoid over the raw area. When this latter procedure is carried out, the large bowel adheres and seldom if ever, becomes obstructed because of such adherence.

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culture positive for Escherichia coli and sedimentation rates 106 to 127 mm
in one hour The patient was immediately hospitalized and treated with pelvic
diathermy penicillin a diet high in calories and in vitamins iron and vitamin
supplements Administration of penicillin was discontinued ten days after admis-
sion, but the other measures were continued for fifty days Little change had
occurred in the pelvis when the patient was dismissed from the hospital

caused some elevation of both urea and the leukocyte count

When the pelvis was explored on December 18, bilateral tubo-ovarian abscesses were found. Subtotal abdominal hysterectomy, bilateral salpingo oophorectomy and appendectomy were done. The surgeon stated that there was too much inflammatory reaction about the base of the bladder and the broad ligaments to permit performance of total hysterectomy. The postoperative course was afebrile, the patient being dismissed from the hospital on the tenth postoperative day. During the postoperative period penicillin and dicumarol were administered.

It is obvious that in this case the patient did not respond to conservative medical management that was thorough and prolonged. The medical management had considerable value, however, as it gave assurance of a relatively safe surgical risk. It might be that diathermy would have been more effective had it been started at the onset of the illness. The efficacy of administration of penicillin as a preoperative and postoperative measure is emphasized by this patient's smooth postoperative course which was completely afebrile.

CASE 4—A white woman, forty two years old, was first registered at the Clinic on June 4, 1946. Physical examination revealed a squamous cell epithelioma of the cervix, grade 3 (Broders' method), stage 2. Laboratory data were negative except that the Wassermann test gave strongly positive results. From June 20 to July 13 full courses of radium and roentgen therapy were administered for the carcinoma of the cervix. On October 2 examination revealed a good local result from this treatment. A second course of roentgen therapy was administered from October 3 to October 7. On October 14 the patient returned complaining of a great deal of pain in the lower part of the abdomen. On examination the temperature was found to be 103° F. The pelvis was exquisitely tender and the uterus was fixed to the right. The uterus was probed, with negative results. The sedimentation rate was 129 mm in one hour. The patient was immediately hospitalized and given large doses of penicillin plus the usual supportive treatment. Diathermy was started a few days after admission. On November 4 the pelvic disease had extended to points above the umbilicus on the right and just below the umbilicus on the left. The sedimentation rate remained elevated. The septic type of temperature subsided on November 8 and the patient was dismissed from the hospital on November 23. On December 4 the patient was readmitted to the hospital with chills, fever and low back pain. Her temperature was 104° F the day after admission and her sedimentation rate was 133 mm in one hour. The temperature was immediately lowered after administration of penicillin. Pelvic diathermy was again started. The symptoms were found to be due to infection of the urinary tract. The patient was dismissed from the hospital on December 15 but was continued on treatment of the infection of the urinary tract and on treatment with pelvic diathermy as an outpatient. A pelvic examination on December 19 was essentially negative; no clinical evidence of either carcinoma or pelvic inflammatory disease was found. When last seen on January 29, 1947, the patient was gaining weight and was feeling well.

It is probably true that pelvic inflammatory disease following radiation therapy given for a malignant lesion can be treated only by conservative or medical measures. It is believed that diathermy and therapy with antibiotic substances were entirely responsible for this patient's recovery.

SUMMARY AND COMMENT

One should re-emphasize the fact that the medical and surgical treatments of pelvic inflammatory disease are to be used to complement one another. We feel that all patients suffering from such disease should first receive conservative medical management. Early and adequate medical treatment by our present-day methods should cause a marked decrease in the number of instances in which surgical intervention is required. If possible therapy should be started when the infectious process is limited to the urethra and cervix in the gonorrheal type of infection and when the very first sign of visceral involvement occurs in other types of infection. Certainly a good end result, with salvage of the reproductive function will hinge to a great extent on such early and adequate treatment. With such treatment a clinical cure will often be effected, in those cases in which cure is not effected by such treatment the patient will be in better condition to undergo operation.

CLINICS ON OTHER SUBJECTS

CARCINOMA OF THE RIGHT (PROXIMAL) PORTION OF THE COLON

CHARLES W. MAYO

THE diagnosis and management of carcinoma of the right half of the colon requires an understanding of the anatomy, physiology and pathology of this segment of the large intestine

Embryologically, the right half of the colon develops from the midgut. The midgut extends from the papilla of Vater to the middle of the transverse colon. This portion of the intestinal tract receives its blood supply from branches of the superior mesenteric artery. The ileocolic artery, which is the lowest branch of the superior mesenteric artery, furnishes the blood supply to the appendix, cecum and the lower part of the ascending colon. The right colic artery which also carries blood to the right portion of the colon is subject to considerable variation in its origin, size and even its presence. Steward and Rankin found that it was absent in 18 per cent of specimens studied and that it originated from the superior mesenteric artery in 40 per cent, from the middle colic artery in 30 per cent, and from the ileocolic artery in 12 per cent. The marginal artery of the right half of the colon courses through the mesentery of the bowel and runs parallel to it. The marginal artery is in reality the large anastomosing artery connecting the ileocolic and right colic arteries.

The lymph vessels arise in the submucosa and subserosa to form plexuses which drain to the various groups of nodes. The epiploic nodes are small nodes located under the serosa. Efferent vessels from this group of nodes pass to the paracolic and intermediate groups of nodes. Occasionally an efferent vessel will bypass the paracolic nodes and go directly to the intermediate group or even to the main group of nodes. The occasional finding of metastatic carcinoma in a node near the origin of one of the main blood vessels without involvement of nodes near the primary tumor can be explained by this phenomenon.

The etiology of carcinoma of the colon is unknown. However, the pathogenesis of intestinal polyps from the earliest epithelial change to frank carcinoma has been traced.² In a study of adenomas of the colon³ from 1460 consecutive necropsies the incidence of adenomas in persons more than thirty years of age was 16 per cent. Malignant transition was present in 7.2 per cent of the adenomas.

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histologic grade of malignancy Likewise, the higher the histologic grade of malignancy the deeper the mural penetration likely to be found and the more likely it was that lymph nodes would be involved

In addition to spread by lymphatic channels, carcinoma can spread by involvement of veins and along the nerves Venous involvement indicates a grave outlook It is extremely unlikely that any patient who has venous involvement will be alive three years after resection¹⁰

DIAGNOSIS

Unfortunately, there are no characteristic symptoms of carcinoma of the colon The onset is insidious and symptoms usually are present for about a year before the diagnosis finally is made Occasionally an advanced or inoperable carcinoma is found during a routine examination which apparently had not produced previous symptoms Careful inquiry, however, usually uncovers the fact that these stoic individuals have been disregarding certain symptoms for many months

Age should not obviate the consideration of carcinoma of the colon Although it is uncommon among persons less than thirty years of age, nevertheless about 2 per cent of patients are in this younger age group

As mentioned previously, the character of lesions of the right portion of the colon influences the symptoms produced The caliber of this portion of the colon is large, the tumors are papillary rather than constricting the stool is liquid, and obstruction seldom occurs Blood constantly oozing from the large ulcerated surface produces an iron deficiency type of anemia which responds to iron therapy⁴ In many cases an erroneous diagnosis of pernicious anemia is made and treatment with iron, liver extract, or both is given for a protracted period The anemia responds favorably to such treatment and thus the delay in arriving at the diagnosis of carcinoma is prolonged Blood in the stool is seldom recognized by the patient as it is well mixed with the stool and does not appear on the surface

Due to this lack of definite symptoms, medical advice is not requested early for lesions of the right portion of the colon The earliest symptoms usually occur from six months to a year or more before the diagnosis of a malignant lesion of this portion of the colon is made

Symptoms.—Symptoms produced by carcinoma in the right half of the colon can be considered under four headings (1) pain, (2) dyspepsia (3) weakness, and (4) change in bowel habit

Pain—Abdominal discomfort of some type occurs in most cases It may be merely a "heavy feeling" a sense of fullness, "trapped gas" or a soreness in the right side The discomfort may be localized to the right side, but occasionally it is in the epigastrium These vague symptoms may simulate those of chronic appendicitis, chronic cholecystitis, or even may be interpreted as indicating peptic ulcer Occasionally

The histogenesis of carcinoma of the intestine and of benign intestinal polyps has been summarized by Ewing who stated that the transition in the early stages for one was essentially the same as that for the other. In the light of present knowledge of polyps (adenomas) of the colon it is not surprising that multiple carcinomas of the colon are not uncommon. It is well to remember that any patient dying of a so-called recurrent carcinoma eight or ten years after resection of the colon for a malignant lesion may well have died of another primary neoplasm of the colon.

In this presentation the term "right portion of the colon" is used to include the cecum, ascending colon and hepatic flexure.

PATHOLOGY

Carcinoma of the right portion of the colon and cecum almost always is grossly papillary in character. The hard, infiltrating, encircling, napkin ring type so common in the distal part of the colon is rarely seen in the proximal part. The papillary type of carcinoma grows into large fungating cauliflower like lesions which project into the lumen and have a large, friable, easily bleeding surface. The average surface area of carcinoma of the cecum at time of operation is 51.6 square cm.¹ Oozing of blood from this large surface for a long period produces the marked anemia so often associated with carcinoma of the cecum and ascending colon.

Carcinoma of the colon tends to ulcerate and become secondarily infected. Occasionally an infected and inflamed malignant lesion becomes adherent to a neighboring organ. This adherence may be entirely due to inflammation, but often the malignant lesion has involved the adjacent structure. When resection is being performed for carcinoma of the proximal part of the colon it may be necessary to remove the right kidney or ureter, a segment of the abdominal wall

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colon. It was concluded that the deeper the carcinomatous penetration the greater was the probability of involvement of lymph nodes and the greater was the probability that the growth would be of a higher

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a lesion at the hepatic flexure will cause obstruction with colicky pain. This, of course, could be mistaken easily for acute cholecystitis or stone in the common duct. Perforation of a lesion onto the kidney or ureter may give rise to pain referred to the back.

Dyspepsia—Complaints of anorexia, sour stomach, postprandial distress and epigastric fullness are not uncommon in carcinoma of the proximal half of the colon.

Weakness—Weakness occurs in cases of lesion of the right portion of the colon frequently because of the loss of blood and the resulting anemia. Weakness and fatigue may be due to loss of weight which occurs in about half of the cases. Shortness of breath is a common complaint associated with the weakness and anemia.

Change in Bowel Habit—A change from the normal habit of

alternating diarrhea and constipation.

Examination.—The vast majority of patients who have carcinoma of the colon, and practically all when they first seek medical advice, appear at least as healthy as the average patient visiting his physician. Cachexia, emaciation, and dehydration are seen only after long neglect by the patient, his physician, or both.

An abdominal mass can be palpated in about 75 per cent of the cases of carcinoma of the right portion of the colon. Occasionally the patient discovers the mass while bathing or it is found during a routine examination by his physician. Tenderness is dependent on associated inflammation and perforation. Fever in the presence of tenderness and fixation of the mass is indicative of perforation.

Metastatic spread to the liver rarely can be diagnosed from palpation of the abdomen and the edge of the liver at the costal margin. The presence of ascitic fluid is a more reliable index of hepatic involvement.

A thorough rectal and proctosigmoidoscopic examination should be done in every case of carcinoma of the right portion of the colon as multiple lesions are occasionally found. A second lesion in the rectum or rectosigmoid might be impossible to visualize on roentgenologic examination but could be found easily by rectal or proctosigmoidoscopic examination.

Roentgenologic Examination—Roentgenologic examination of the colon cannot be done without adequate preparation. No one would think of doing barium studies of the stomach after the patient had eaten breakfast, yet the same situation exists when the colon is full. On the day before roentgenologic examination the evening meal should be omitted and 2 ounces (60 cc) of castor oil administered.

The next morning the distal part of the colon and rectum should be cleansed by one or two plain low enemas. Saline cathartics should not be used to cleanse the colon. Such cathartics draw water into the intestinal lumen, and a patient so prepared presents himself to the roentgenologist with his colon uncleaned and containing considerable fluid which prevents its filling with barium and destroys the suspension of the latter. A good suspending agent should be used for the barium to facilitate careful examination of the mucosal surface of the colon.

The mucosal pattern should be viewed roentgenoscopically by a trained roentgenologist. Often evidence of the presence of carcinoma of the colon cannot be seen in the roentgenogram of the colon filled with barium yet the roentgenologist could see the lesion during roentgenoscopic examination as the barium flowed around and over the tumor. Small polypoid lesions are difficult to demonstrate by ordinary roentgenologic methods unless roentgenograms are made after inflation of the colon with air after the barium has been expelled.

Comment.—The diagnosis of a malignant lesion of the right portion of the colon is not difficult to establish for the one who eventually makes the diagnosis. This is due in part to the fact that in so many cases the lesion is advanced when the final diagnosis is made. Delay in diagnosis often is due to neglect on the part of the patient because he does not think the symptoms are serious and because he does not consider carcinoma. This lack of a better informed laity is indirectly the fault of the medical profession. It has been estimated⁸ also that it might have been possible for the physician to make a diagnosis of carcinoma of the colon in more than 30 per cent of cases. In 15 per cent of a large series of cases of carcinoma of the right portion of the colon appendectomy had been performed after the onset of symptoms attributable to the malignant lesion.¹¹

If a simple, definite routine of examination is followed in every case in which carcinoma is suspected and in all cases in which vague abdominal symptoms are present, an earlier diagnosis and a better chance of cure will result. The simple routine of examination should consist in careful palpation of the abdomen, roentgenologic examination of the colon after a barium enema and proctosigmoidoscopic examination. This routine should be carried through to completion in any case in which (1) a change in bowel habit, (2) passage of blood from the rectum, (3) vague symptoms of abdominal discomfort or (4) loss of weight, weakness or unexplained anemia has occurred, or an abdominal mass is found.

DIFFERENTIAL DIAGNOSIS

In making a differential diagnosis of malignant lesions of the right portion of the colon the following conditions should be considered: appendicitis, appendiceal abscess, tuberculosis of the cecum, entero-

colitis, amebiasis, renal tumors, diverticulitis of the cecum, anemia, disease of the gallbladder and peptic ulcer. As has been mentioned 15 per cent of the patients who are found to have carcinoma of the right portion of the colon have undergone appendectomy after the onset of symptoms referable to the malignant process. In any case in which the patient is more than thirty years of age when appendectomy is performed, the incision should be large enough to permit exploration of the cecum and ascending colon.

With the return of military personnel from overseas, amebiasis merits mention in the differential diagnosis of carcinoma of the cecum. The incidence of amebiasis is as high as 40 per cent in some parts of the United States and it is conservatively estimated that 5 to 10 per cent of the people of this country harbor the parasite. According to reports from the Presbyterian Hospital in New York City, amebiasis of the cecum appears to be encountered more frequently on roentgenologic examination than is carcinoma or tuberculosis of the cecum. A deformity of the cecum is found in more than a third of the cases of amebiasis. Such cecal deformity although usually quite typical has been interpreted as carcinoma. The seriousness of such an error cannot be overemphasized because the operative mortality in the presence of amebiasis is high.

Amebiasis more frequently is associated with constipation than with diarrhea. Severe diarrhea with a bloody discharge, occurs in a small number of cases of amebiasis. Repeated examinations of stools confirm the diagnosis. Any patient with carcinoma of the colon who has been in an area where amebiasis is prevalent should have several stool examinations.

PREOPERATIVE PREPARATION

The patient should be hospitalized for four to five days before operation for adequate preparation. Transfusions of whole blood

OPERATION

There are several methods of surgical management of carcinoma of the right portion of the colon. Some surgeons prefer a two stage procedure, such as ileotransverse colostomy followed in several weeks by resection of the right portion of the colon. Other surgeons exteriorize the end of the ileum at the time of the resection as a "vent" above the anastomosis and still others perform a Witzel type of ileostomy above the anastomosis. In 1938 Lovelace and I reviewed 885 cases of malignant lesions of the cecum and ascending colon and found that the mortality rate was 6 per cent higher in the ninety eight cases in which a Witzel type of enterostomy had been performed above the anastomosis than in the cases in which it had not been performed.

For the past several years I have been performing a one stage right hemicolectomy for carcinoma of the right portion of the colon with an end to end open type of anastomosis between the terminal portion of the ileum and the transverse colon. This procedure has proved satisfactory in every respect and the surgical mortality has been surprisingly low. I have not found it necessary to use a Miller Abbott or double lumen tube preoperatively or postoperatively except in the rare case in which obstruction was present. I believe an important part of the maneuver is to dilate the anus thoroughly so that the patient cannot hold gas.

Several technical points are worthy of mention. After the blood vessels supplying the segment to be removed have been ligated, it is well to wait until a line of demarcation develops before a decision is made concerning the site at which the ileum and the transverse colon are to be cut. If this is done the blood supply to the line of anastomosis will be sufficient. The terminal portion of the ileum should be incised at an angle; this insures an adequate blood supply to the cut end and also enlarges the opening to more nearly the size of that of the colon. The terminal portion of the ileum and colon should be cut with a cold knife and not with cautery. Cautery devitalizes tissue for an unknown depth in the region where the anastomosis is to be made. The open type of anastomosis is the safest. So called aseptic methods require some type of crushing clamp which also devitalizes tissue and turns in a large cuff of bowel which narrows the lumen. Soiling during the operation is not to be feared. It is continued leakage from the site of the anastomosis after the abdomen has been closed that can cause fulminating peritonitis. When an open type of anastomosis is performed every stitch can be placed carefully. When non-absorbable sutures such as cotton or silk are used a continuous suture all the way around the intestine at the anastomosis should not be employed because this prevents stretching of the bowel at this point. I have found an outer row of interrupted cotton sutures and a continuous inner mucosal row of catgut to be satisfactory. Two rows of

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PREOPERATIVE PREPARATION

The patient should be hospitalized for four to five days before operation for adequate preparation. Transfusions of whole blood should be given if necessary, in order to have a hemoglobin level of at least 10 gm per 100 cc of blood. The diet should contain non residue foods which are
Milk, whole vegetables

Twice a day for three

irrigations should be
on

m, should be given
fast four days before

operation. Paregonic should be given in doses of 8 cc at 2 p.m. and 10 o'clock the afternoon and evening before operation, to put the bowel at rest.

COMMENT

Some evidence indicates that the public is becoming more cancer conscious and is seeking the help of the physician earlier than formerly. Sufficient proof is lacking, however, to consider this statement anything but a supposition.

The physician is being educated to suspect and investigate the colon in cases in which anemia, fatigability and weakness exist; also he is more aware of the fact that persistent digestive disturbances combined with a change of intestinal habit demand roentgenographic study of the colon.

The results of surgical treatment of malignant lesions of the right portion of the colon are fast arriving at a point where the responsibility for further improvement in end results is going to depend on earlier diagnosis so that treatment can be undertaken before the malignant process has reached a point that will limit the value of resection.

One stage resection of the right portion of the colon can be performed with a lower mortality rate and lower morbidity rate than can multiple stage procedures. One-stage resection, with rare exceptions, can be performed in any case in which a multiple stage procedure also is feasible. One stage resection of the right portion of the colon with end to end ileotransverse colostomy is an operation that has given very satisfying results.

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sutures are enough if more are used, a larger cuff of bowel is turned in and more of the blood supply is tied off. A Penrose drain should be brought out through a stab wound in the right flank.

POSTOPERATIVE TREATMENT

A transfusion of 500 c c of whole blood should be given immediately

to maintain an adequate urinary output. Saline solution should not be used for the first twenty-four or forty-eight hours after operation unless a tube has been placed in the stomach or in the intestine. It is well to give oxygen through a mask for two or three days to any patient who has undergone intestinal anastomosis. About forty-eight hours after the operation the patient usually can begin to take water and the following day a nonresidue liquid diet. A nonresidue solid diet can be taken about the fourth postoperative day and a low residue diet can be started about one week after the operation. The drain is left in place about twelve to fourteen days or longer if drainage occurs. The patient usually can be out of bed three or four days after the operation.

REVIEW OF CASES FROM 1910 THROUGH 1946

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WALTMAN WALTERS, HAROLD A. NEIBLING, WILLIAM F. BRADLEY,
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Just one year ago, Dragstedt presented at a meeting of the Minneapolis Surgical Society, the results of resection of the vagus or gastric nerves in fifty four cases of peptic ulcer in which he had performed the operation during the preceding three years. He said "This is too short a time to draw final conclusions concerning the value of any therapeutic measure in this disease. The discussion, therefore, must be considered in the nature of a progress report." This statement coincides with our views at present, after study of eighty patients who have undergone gastric neurectomy* at the Mayo Clinic.

Dragstedt stated further that "trans thoracic supradiaphragmatic section of the vagus nerves is recommended as a substitute for subtotal gastrectomy for duodenal ulcers in the absence of cicatricial stenosis of the pylorus, gastrojejunal ulcers and for gastric ulcers where the diagnosis is certain. Transabdominal vagus section plus gastroenterostomy is recommended for duodenal ulcers with cicatricial pyloric stenosis." Our studies lead us to disagree with this viewpoint.

Of the fifty four patients on whom Dragstedt operated, one died from aspiration pneumonia. The vagus or gastric nerves of thirty-nine were divided above the diaphragm, and of the remaining fifteen below the diaphragm. Two patients had gastric ulcers, eight had gastrojejunal ulcers, and forty-four had duodenal ulcers. Concerning the results he commented "Except for one woman with a duodenal ulcer in whom subsequent testing indicated that a complete vagotomy was not secured, the result has been immediate, complete and permanent symptomatic relief of pain, gain in weight and, in most cases, objective evidence of healing of the ulcers. There have been no recurrences to date, no hemorrhages and no perforations. Fifteen of the patients required gastroenterostomy at the time of the vagus section or subsequently because of cicatricial pyloric stenosis. One patient with a jejunal ulcer following gastric resection, continued to display obstructive symptoms and a subtotal resection was subsequently done elsewhere. The residual symptoms were due to obstruction and not to persistence of an ulcer which had healed."

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Just one year ago, Dragstedt presented at a meeting of the Minneapolis Surgical Society, the results of resection of the vagus or gastric nerves in fifty four cases of peptic ulcer in which he had performed the operation during the preceding three years. He said "This is too short a time to draw final conclusions concerning the value of any therapeutic measure in this disease. The discussion therefore, must be considered in the nature of a progress report." This statement coincides with our views at present, after study of eighty patients who have undergone gastric neurectomy* at the Mayo Clinic.

Dragstedt stated further that "transthoracic supradiaphragmatic section of the vagus nerves is recommended as a substitute for subtotal gastrectomy for duodenal ulcers in the absence of cicatricial stenosis of the pylorus, gastrojejunal ulcers and for gastric ulcers where the diagnosis is certain. Transabdominal vagus section plus gastroenterostomy is recommended for duodenal ulcers with cicatricial pyloric stenosis." Our studies lead us to disagree with this viewpoint.

Of the fifty four patients on whom Dragstedt operated, one died from aspiration pneumonia. The vagus or gastric nerves of thirty nine were divided above the diaphragm, and of the remaining fifteen below the diaphragm. Two patients had gastric ulcers, eight had gastrojejunal ulcers, and forty-four had duodenal ulcers. Concerning the results he commented "Except for one woman with a duodenal ulcer in whom subsequent testing indicated that a complete vagotomy was not secured, the result has been immediate, complete and permanent symptomatic relief of pain, gain in weight and, in most cases, objective evidence of healing of the ulcers. There have been no recurrences to date, no hemorrhages and no perforations. Fifteen of the patients required gastroenterostomy at the time of the vagus section or subsequently because of cicatricial pyloric stenosis. One patient with a jejunal ulcer following gastric resection, continued to display obstructive symptoms and a subtotal resection was subsequently done elsewhere. The residual symptoms were due to obstruction and not to persistence of an ulcer which had healed."

* Gastric neurectomy is used synonymously with section of the vagus nerves and vagotomy.

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FAVORABLE AND UNFAVORABLE RESULTS OF GASTRIC NEURECTOMY (VAGOTOMY) FOR PEPTIC ULCER—ANATOMIC, PHYSIOLOGIC AND CLINICAL STUDY

WALTMAN WALTERS, HAROLD A. NEIBLING, WILLIAM F. BRADY,
JOHN T. SMALL AND JAMES W. WILSON

Just one year ago, Dragstedt presented at a meeting of the Mayopolis Surgical Society, the results of resection of the vagus or gastric nerves in fifty four cases of peptic ulcer in which he had performed the operation during the preceding three years. He said "This is only a short time to draw final conclusions concerning the value of this therapeutic measure in this disease. The discussion, therefore, must be considered in the nature of a progress report." This statement agrees with our views at present, after study of eighty patients who have undergone gastric neurectomy* at the Mayo Clinic.

Dragstedt stated further that "transthoracic supradiaphragmatic section of the vagus nerves is recommended as a substitute for total gastrectomy for duodenal ulcers in the absence of cicatricial stenosis of the pylorus, gastrojejunal ulcers and for gastric ulcers where the diagnosis is certain. Transabdominal vagus section and gastroenterostomy is recommended for duodenal ulcers with cicatricial pyloric stenosis." Our studies lead us to disagree with this viewpoint.

Of the fifty four patients on whom Dragstedt operated, one died from aspiration pneumonia. The vagus or gastric nerves of thirty three were divided above the diaphragm, and of the remaining twenty one below the diaphragm. Two patients had gastric ulcers, eight had gastrojejunal ulcers, and forty four had duodenal ulcers. Concerning the results he commented "Except for one woman with a duodenal ulcer in whom subsequent testing indicated that a complete vagotomy was not secured, the result has been immediate, complete and permanent symptomatic relief of pain, gain in weight and, in most cases, objective evidence of healing of the ulcers. There have been no recurrences to date, no hemorrhages and no perforations. Fifteen patients required gastroenterostomy at the time of the vagotomy or subsequently because of cicatricial pyloric stenosis. One patient with a jejunal ulcer following gastric resection, continued to have obstructive symptoms and a subtotal resection was subsequently performed elsewhere. The residual symptoms were due to obstruction, not to persistence of an ulcer which had healed."

* Gastric neurectomy is used synonymously with section of the vagus.

The equally favorable reports of Grimson, Ruffin and associates^{4 5 10} concerning thirty patients operated on at Duke University and of Moore and his associates at the Massachusetts General Hospital concerning twelve patients have led us to study the problem from the anatomic, physiologic and chemical standpoint, in eighty patients who

TABLE 1
GASTRIC NEURECTOMY ALL CASES TO JANUARY 1 1917

Operation Type	Total	Operation Performed for			
		Duodenal Ulcer	Gastrojejunal Ulcer	Gastric Ulcer	Gastritis
Gastric neurectomy only	32	16	14	2	0
Gastric neurectomy with gastro-enterostomy	30	30	0	0	0
Gastric neurectomy with excision of ulcer	18	5*	10	3*	1
Total	80†	51*	24	5*	1

* Both duodenal and gastric ulcers in 1 case

† Three additional patients operated on up to Jan. 15 1917 but are not included

have undergone gastric neurectomy in the treatment of peptic ulcer at the Mayo Clinic (table 1) Four of these patients were operated on recently and were still in the hospital on January 9 1917

HISTORICAL DATA

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stomach have been confused and the results of section of the gastric or vagus nerves of man have been compared indiscriminately with those obtained for lower animals Many workers have employed operations of varying extent in the treatment of peptic ulcer and others have employed this procedure in the experimental production of peptic ulcer

Seventeen years ago working in the Division of Experimental Medicine of the Mayo Foundation Hartzell studied the effects of intra

thoracic and abdominal section of the vagus nerves of eight dogs. On six intrathoracic vagotomy had been performed and on two abdominal vagotomy. The immediate findings revealed total abolition of psychic secretion (cephalic phase), marked and constant reduction of the quantity of free hydrochloric acid and of the total acids and an increase in the hydrogen ion concentration of the gastric secretion. Two and a half years later Vanzant,¹² working in the same laboratory, studied some of the same group of dogs and an additional group. She found that in all of the dogs of the original group that she studied the amount of total and free acid had increased five to six months after operation and that free acid was present in all but one of the original group studied two to three years after operation. Eventually in four of the dogs, curves of free and total acid approached normal. Effects of vagotomy on motility of the stomach were inconstant. Early studies after operation recently reported by Vanzant¹³ disclosed that in four dogs delayed emptying of the stomach occurred, two dogs had hypermotility with a tendency to diarrhea and emesis, and three dogs had no change in emptying time. Later results revealed the motility of the stomach of seven of ten dogs to be essentially normal. The general health of six dogs was not impaired except for excessive salivation which gradually lessened. Two dogs vomited frequently following the operation. Three dogs had increased appetites in spite of which they lost weight. Of these, two also had a tendency toward diarrhea.

In order to study the problem of gastric neurectomy at the Clinic we have gathered together a small group of men in the divisions of surgery, medicine and experimental medicine who could work together and determine the type of ulcer for which the procedure could be used with advantage and to study the results of the operation in these cases. At about this time, Dr. Edwin Miller, of Chicago, who had made some dissections of the vagus nerve of human beings and had found considerable variation in their position, number and size suggested that we carry out similar anatomic studies. This was done in the Section on Pathologic Anatomy under the direction of Dr. James Kernohan and has been reported in detail elsewhere. Only brief mention of the results will be made at this time.

ANATOMIC VARIATIONS OF GASTRIC NERVES

Anatomic dissection of the gastric nerves were made on fifty-six men, forty-four women and eleven children. Generally speaking, the gastric nerves arose from the esophageal plexus at about the level of the bifurcation of the trachea. The right and left nerves coursed caudad and usually terminated on the stomach. In ninety-two of the specimens from adults studied at necropsy a rather regular pattern was followed in forming discrete nerve trunks from the esophageal

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Total	80†	51*	21	5*	1

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HISTORICAL DATA

Denervation of the stomach in the treatment of pain and peptic ulcer is not a new concept and an extensive and confusing literature has appeared since Brodie's first report in 1814. Review of the literature reveals that the early and late effects of denervation of the stomach have been confused and the results of section of the gastric or vagus nerves of man have been compared indiscriminately with those obtained for lower animals. Many workers have employed operations of varying extent in the treatment of peptic ulcer and others have employed this procedure in the experimental production of peptic ulcer.

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tion of the ulcer, (3) its removal if it is a gastric ulcer and is suspected of being malignant and (4) some type of drainage operation of the stomach if needed. Drainage operation is indicated when an obstructive duodenal ulcer or a duodenal ulcer that is likely to become obstructive is present, or when gastric atony occurs after gastric neurectomy. Patients who have duodenal ulcer of the types just mentioned usually have failed to respond to nonsurgical (medical) treatment. The abdominal approach also is useful in cases in which a gastrojejunal ulcer has followed gastroenterostomy, for not infrequently repeated ulceration at the stoma has resulted in obstruction and reactivation of the duodenal ulcer. In such cases, removal of the gastrojejunal ulcer and disconnection of the gastro-enteric anastomosis are necessary in addition to gastric neurectomy. If obstruction of the duodenum has resulted from reactivation of the duodenal ulcer or from its healing after gastroenterostomy, pyloroplasty also seems indicated. In one case in which an ulcer recurred after gastric resection had been performed elsewhere, perforation of the anastomotic ulcer into the colon was impending at the time of operation. When this situation was found, we felt that a more extensive gastric resection was indicated with removal of the anastomotic ulcer even though gastric neurectomy was done also. In other words we have tried to prevent postoperative gastric stasis and retention of secretion by anticipating that it might occur and compensating for it by a drainage operation on the stomach at the time of gastric neurectomy rather than later.

The two cases which follow illustrate some of the advantages of an abdominal approach.

A recent patient, a man aged thirty three years who had had three severe hemorrhages without associated pain was sent to the hospital for gastric neurectomy. At the time of admission he had had three gastric ulcers with craters on the day of admission. The first ulcer had necessitated postponement of the operation.

... a large Meckel's diverticulum was found. This could have been a source of the intestinal bleeding. If the transthoracic approach had been used in this case the diverticulum would not have been found. The appendix also showed a considerable degree of inflammation with impaction of fecal concretions. Partial gastrectomy, diverticulectomy and appendectomy were performed.

Another patient a man forty five years of age who gave an excellent history of duodenal ulcer had been operated on twice previously. On the first occasion his gallbladder and appendix had been removed and on the second it was thought he had a duodenal ulcer but none was found at operation. The indication for the third operation was a history of an active duodenal ulcer for more than two years. Roentgenologic examination seemed to show an ulcer with crater on the posterior wall of the duodenum. No induration or ulceration of the duodenum could be felt at the time of operation. An incision was made through the anterior portion of the pylorus and the duodenum and lower portion of the stomach were

plexus In sixty four of these cases the nerve trunks formed between the esophageal hiatus and 6 cm above the diaphragm, in twenty-one at the distance of 6 cm above the diaphragm, and in seven at the esophageal hiatus In eight cases, it was impossible to isolate two distinct trunks at any point since the branches were numerous inter communicated and failed to follow a uniform pattern

The position of the right and left trunks at the esophageal hiatus was noted in ninety two cases and was found to be remarkably constant The right gastric nerve, the larger in fifty four cases coursed posteriorly and to the left and then broke up into its branches about 3 to 5 cm below the hiatus The largest branch of the right nerve invariably traveled along the left gastric artery to the celiac plexus Of the two trunks the left followed a much shorter course in the abdomen As it emerged from the hiatus onto the anterior surface of the stomach, it immediately divided into numerous small branches which were lost in the serosa and musculature of the stomach Branches from both the right and left nerves invariably entered the leaves of the gastrohepatic omentum

These anatomic studies indicated, therefore, that the gastric nerves could be located successfully in approximately 92 per cent of the cases, and possibly many of the branches in the remaining 8 per cent by a transabdominal approach

CLINICAL STUDIES

The clinical application of these anatomic studies supplemented with studies of gastric motility and gastric secretion has been made to the treatment of peptic ulcer in eighty cases* at the Mayo Clinic The lesions for which gastric neurectomy was performed are listed in tables 1 and 2

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A recent patient, a man aged thirty-three years, who had had three severe hemorrhages without associated pain, was sent to the hospital for gastric neurectomy. A severe hemorrhage from three duodenal ulcers with craters on the day preceding the scheduled time of his operation necessitated postponement of the surgical procedure fifteen days. At operation a large Meckel's diverticulum was found which also could have been a source of the intestinal bleeding. If the transthoracic approach had been used in this case the diverticulum would not have been found. The appendix also showed a considerable degree of inflammation with impaction of fecal concretions. Partial gastrectomy, diverticulectomy and appendectomy were performed.

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TABLE 3

GASTRIC NEURECTOMY (VAGOTOMY) AUTHORS' CASES

Case	Lesion	Total and Free Acids		M in anal blood sugar mg per 100 cc	Curve of fecal acidity	Roentgenologic findings	Comment and Results
		Before Operation	After Operation				
1	Gastrojejunal ulcer	49/12 45 cc	40/0 40 cc	20	Flat		Early good results, later loss of appetite for 4 or 5 weeks, no pain
2	Gastrojejunal ulcer	55/16 60 cc	12/0 75 cc (night)	35	Flat	Moderate delay in emptying	Excellent relief
3	Gastric ulcer		46/0 60 cc (night)	53	Flat	Atonic stomach, considerable secretion	Good relief early but persistence of retained secretions
4	Gastric ulcer		40/0 40 cc (night)	22	Downward	Normal motility	Good relief
5	Filleted duodenal ulcer		10/0				Relieved on 900 to 2300 cc 4 to 9 postoperative days
6	Duodenal ulcer	65/35 75 cc	6/0 141 cc (night)	23	Downward		Dramatic relief
7	Duodenal ulcer	15/21 10 cc	40/18 100 cc	7 (incorrect)	Upward		Good relief
8	Duodenal ulcer	6/16 115 cc	14/0 10 cc	10	Flat	Normal	Early good relief, some diarrhea
9	Duodenal ulcer	60/40	20/0 50 cc			Duodenal ulcer with no crater, normal motility	Good relief
10	Duodenal ulcer	65/52 130 cc	34/20 450 cc (night)	18	Downward	Considerable secretion on stomach	Good relief
11	Refractory duodenal ulcer	80/60	28/12	26	Downward	Atony of stomach	Good relief
12	Duodenal ulcer		46/10	35	Downward	Early postoperative duodenal ulcer present	Good relief
13	Duodenal ulcer	None	60/48	17	Upward	Retained secretion on pylorospasm	Good relief
14	Duodenal ulcer	44/36	Died one hour after operation on coronary insufficiency				

then opened for inspection. No ulcer was present, although some duodenitis was found. Consequently, pyloroplasty rather than a gastric neurectomy (vagus nerve resection) was performed. If gastric neurectomy had been done through the transthoracic approach, the absence of a duodenal ulcer would not have been discovered and the results of the operation which followed would have been misinterpreted because no ulcer was present.

Colp had a similar experience in a case in which a tumor of the stomach in addition to an ulcer was considered likely before operation. At exploration neither was found.

Since in most cases in which operation is performed for duodenal ulcer at the Mayo Clinic lesions are complicated by obstruction or bleeding, it is easy to understand why gastric neurectomy through an abdominal incision is the procedure of choice in our experience.

Gastric neurectomy has been performed without any other associated operative procedure in only fourteen of forty cases in which the operation has been carried out by one of us (W W) (tables 2 and 3).

TABLE 2
AUTHORS' CASES TO JANUARY 1 1917

Operation Type	Total Cases	Operation Performed for			
		Duodenal Ulcer	Gastrojejunal Ulcer	Gastric Ulcer	Gastritis
Gastric neurectomy only	14	10	2	2	0
Gastric neurectomy with gastro-enterostomy	15	15	0	0	0
Gastric neurectomy with excision or resection	11	3*	5	3*	1
Total	40	28*	7	5*	1

* One patient had both duodenal and gastric ulcers

and in only eighteen of the forty cases in which it was performed by other surgeons at the Clinic (table 1). Since gastro-enterostomy and partial gastrectomy without gastric neurectomy have been followed by relief of pain, decrease of night secretion, reduction of gastric acidity and relief of gastrospasm in cases of peptic ulcer, the diffi-

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3	Gastric ulcer		46/0 60 cc (night)	53	Flat	Atonic stomach considerable secretion	Good relief early but persistence of reticent secretions
4	Gastric ulcer		20/0 500 cc (n ght)	42	Downward	Normal motility	Good relief
5	Bleeding duodenal ulcer		10/0				Retention of 900 to 2500 cc 4 to 9 postoperative days
6	Duodenal ulcer	61/51 75 cc	6/0 141 cc (n ght)	23	Downward		Dramatic relief
7	Duodenal ulcer	48/24 150 cc	40/18 100 cc	7 (Incorrect)	Upward*		Good relief
8	Duodenal ulcer	56/16 115 cc	14/0 10 cc	10	Flat	Normal	Early good relief Some delay in P O
9	Duodenal ulcer	60/10	40/0 50 cc			Duodenal ulcer with no gastric normal motility	Good relief
10	Duodenal ulcer	61/51 130 cc	34/10 450 cc (n ght)	28	Downward	Considerable secretion on stomach	Good relief
11	Perforated duodenal ulcer	80/60	46/12	26	Downward	Atony of stomach	Good relief
12	Duodenal ulcer	8/54	46/10	35	Downward	Early P O ludo- nal ulcer present	Good relief
13	Duodenal ulcer	None	60/48	17	Upward	Relicent secretion pylorospasm	Good relief
14	Duodenal ulcer	14/36	10 of one hour after operation of coronary insufficiency				

* Not evened type

GASTRIC NEURECTOMY PLUS SIMULTANEOUS GASTRO-ENTEROSTOMY

Case	Type of Gastro-enterostomy	Lesions	Total and Free Acids and Urea of Luminis		Mental Blood Sugar mg per 100 c.c.	Course of Feeding Test	Hemiplegia before operation	Comment and Results
			Before Operation	After Operation				
15	Posterior	Duodenal ulcer with obstruction	0.56 3.5 c.c.	6/16 30 c.c.	32	Downward		Excellent relief early, diarrhea and loss of weight later
16	Anterior	Infarct of duodenal ulcer	0.88 150 c.c.					Good relief
17	Posterior	Healed gastric ulcer with obstruction	0.65 3.5 c.c.	10.0 30 c.c.			Normal	Good relief
18	Posterior	Infarct of duodenal ulcer	0.34					Good relief
19	Posterior	Perforated duodenal ulcer with obstruction	80.00	16.0 100 c.c.			Normal	Good relief
20	Posterior	Perforated duodenal ulcer with obstruction	80.00	40.0 60 c.c. (in all)	3*	Downward	Constipation	Good relief
21	Posterior	Duodenal ulcer	46.00 17 c.c.	16.0 60 c.c. (in all)	50	Flat	Normal	Good relief
22	Posterior	Duodenal ulcer with obstruction	8.50 200 c.c.	0.0 13 c.c.	—	Flat	Diarrhea with retention of secretions	Excellent relief, good relief, 3 years with food
23	Posterior	Infarct of duodenal ulcer with obstruction		34/100			Gas and emptying of stomach delay in all but 1	3½ a exploration 800 c.c. retention
24	Posterior	Duodenal ulcer with obstruction	60.50 100 c.c.	~7/6 100 c.c.			Diarrhea with retention of secretions	Retention of 2000 c.c. 4 to 14½ days retention, pain and vomiting
25	Posterior	Duodenal ulcer	97/18 50 c.c.	11/0 200 c.c. all	4*	Flat	Diarrhea with retention	Excellent relief, 12 weeks

26	Anterior enterostomy	Duodenal ulcer with obstruction	60/50 175 cc	46/-6			Obstructed on for 14 days	Obstructed on for 16 days good relief
27	Anterior	Duodenal ulcer with obstruction	60/40	64/53 200 cc			Considerable relief on	Retention of 900 cc on 4 P O days poor relief
28		Duodenal ulcer with obstruction	86/76	24/0	42	Downward	Nonfunctioning gastro-enterostomy	Good relief
29		Duodenal ulcer with obstruction	82/72	28/16	26	Downward		

TABLE 3

GASTRIC NEURECTOMY PLUS SIMULTANEOUS GASTRIC OPERATIONS

Case	Lesion	Total and Free Acids and Gastric Contents		Curve of Intest in Test	Reversing of Findings	Comment and Results
		Before Operation	After Operation			
Gastro-enteric anastomosis & duod. excised, ulcer excised						
30	Gastrojejunal ulcer		0.6 1.5 cc (in gtt)	36	Flat	Slight deformity of abdominal cavity in postprandial jejunum
31	Gastrojejunal ulcer	58/42 100 cc	10/0 80 cc (in gtt)	43	Downward	Excellent relief
Gastro-enteric anastomosis & disconnected, ulcer excised, Heister-Mikulicz pyloroplasty						
32	Malignant ulcer on pylorus	72/60 55 cc	81/50 150 cc (in gtt)	30	Downward	Gastric pyloric antrum
33	Gastrojejunal ulcer	54/40 100 cc	60/35 800 cc (in gtt)	70	Downward	Excellent relief
Gastro-enteric anastomosis disconnected, ulcer excised and Finney pyloroplasty operation						
34	Gastrojejunal ulcer	21/10 10 cc	6/0 50 cc		Free anastomosis lower negative	Good relief
Duodenal ulcer excised and gastroduodenostomy						
35	Duodenal ulcer	66/48 100 cc	22/0 35 cc (in gtt)	36	Flat	Good relief

Biopsy of ulcer and cavity

36	Gastric ulcer	12/0	22/0 50 cc (n gb)				Good relief
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Transverse exploratory gastrotomy biopsy of gastric ulcer gastric closure

37	Gastric ulcer and duodenal ulcer	61/52	22/0 800 cc (n gb) 13 11-46 40/26 250 cc	45	Downward	Reoccurrence of ulcers but usually normal emptying of stomach	Moderate early retention poor result
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Gastric ulcer explored

38	Gastric ulcer (healed) duodenal ulcer	50/34 180 cc	28/0 200 cc	45	Upward then downward	Normal	Good relief
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Exploratory gastrotomy only

39	Gastritis	54/42 280 cc	0/0 40 cc	17	Flat	Early normal latent marked atony with gastritis Gastric ulcer on lesser curvature could not be ruled out	Symptomatic relief
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Gastric resection with simultaneous gastric resection

40	Duodenal ulcer with obstruction	60/44	38/0	60	Flat	Atony with retention of secretion, barium remained in stomach	Early relief fullness no return of pain
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TABLE 6

GASTRIC NEURECTOMY (VACUOTOMY) SIGNIFICANT CASES OF OTHER SURGEONS

Case	Transthoracic Approach for	Total and Free Acids and Gastric Contents		Inc in Test	Roentgenologic Findings	Comment and Results
		Before Operation	After Operation			
41	Gastrojejunal ulcer	51/16 183 cc	29/0 210 cc			
42	Gastrojejunal ulcer	67/52 100 cc	11/0 90 cc	Flat	No ulcer. Temporary delay in jejunal emptying.	Excellent relief
43	Gastrojejunal ulcer	36/46 105 cc	18/0 30 cc		Free noation as No gastrojejunal ulcer	Good relief
44	Gastrojejunal ulcer	1911 112/100 150 cc 1915 40 cc 100 cc	17/0 50 cc		Gastrojejunitis	Good relief
45	Duodenal ulcer	60/16 120 cc	50 cc 200 cc	Downward		No plan tendency to return nausea
46	Duodenal ulcer	78/68 100 cc	5 31 16 76 1 cc 300 cc 6 1 46 67/50 150 cc			Good relief
47	Duodenal ulcer (old in relapse)	75 56 100 cc	40/20 40 cc			Early relief on good relief considered
48	Duodenal ulcer	70 46 100 cc	56/30 40 cc		The duodenal ulcer 3 months postoperatively	Early retention. Intermittent vomiting and diarrhea
49	Duodenal ulcer	80/60	10/0		Retention with distention at pylorus	Anterior gastro-enterostomy for obstruction. Two months after operation per day for 30 to 12 days and 12 months after
50	Gastrojejunal ulcer				Much relief and secretions	1) retention of 900 cc in wall of stomach and action therapy with effect

TABLE 7

FREE GASTRIC ACIDITY IN RELATION TO TYPE OF GASTRIC OPERATION
AUTHORS' CASES

Type of Operation	Total Cases	Gastric Acidity before Operation		Gastric Acidity after Operation	
		Determinations Cases	Mean Value Units	Determinations Cases	Mean Value Units
Gastric neurectomy only	14	10	39.4	13	9.4
Gastric neurectomy and gastro-enterostomy	15	14	56.1	13	11.5
Gastric neurectomy and excision					
Gastrojejunal ulcer	5	4	38.0	5	18.8
Gastric ulcer	3	3	20.0	3	0
Duodenal ulcer	2	2	46.0	2	0
Gastritis	1	1	42.0	1	0
Total	11	10	33.1	11	9.4
Grand total	40	34	49.3	37	10.1

TABLE 8

COMPLICATIONS FOLLOWING GASTRIC NEURECTOMY IN EIGHTY CASES

Type of Operation	Total Cases	Retention		Cases	Results
		Early Clinical	Roentgenologic		
Gastric neurectomy only	32	8	9	6	Early pleural effusion
				4	Recurrent epigastric distress
				2	Slight diarrhea
				1	Belching
				2	Loss of appetite
				1	Bleeding from ulcer
				1	Died immediately P O
				1	Died fourth P O day from cerebral embolism (?)
Gastric neurectomy with gastro-enterostomy	30	10	6	1	Recurrent epigastric distress
				1	Diarrhea
				1	Loss of appetite
				1	Vomiting
				1	Loss of weight
				1	Died fourteenth P O day from perforation and sub-diaphragmatic abscess
Gastric neurectomy and excision of ulcer, or resection	18	5	6	1	Belching
				1	Vomiting
				1	Continued pain
				1	Died 3 months P O from coronary occlusion

Results—Gastric acidity and gastric secretion in the group of cases in which gastric neurectomy alone was performed on our service and on some of the other services and in those in which gastric neurectomy was associated with other gastric operations are shown in tables 3 to 7. The complications and failures are indicated in tables 8 and 9.

TABLE 9
FAILURE OF ULCER TO HEAL AFTER GASTRIC NEURECTOMY

Case	Lesion	Gastric Neurectomy	Other Operation	Total and Free Acids		Roentgenologic Findings	Comment and Results
				Before Operation	After Operation		
37	Gastric ulcer and duodenal ulcer	Transthoracic	Facia on through diaphragm	64/52	40/26	Persistent gastric ulcer	Remission of stomach*
39	Gastritis	Abdominal esophagectomy	Esophagectomy	54/4*	80/0	Atony of stomach, gastritis, gastric ulcer (?) on lower curvature	Symptomatic relief*
44	Gastrojejunal ulcer	Transthoracic	None	40/20	12/0	Gastrojejunitis	Overridden and nausea
47	Duodenal ulcer	Abdominal	None	74/56	40/20	Duodenal ulcer 3 months P.O.	Fullness bloating vomiting some diarrhea
48	Duodenal ulcer	Transthoracic	None	70/56	56/30	Retention with obstruction at pylorus	Retention on gastroenterostomy 2 months I.O.; troublesome retention 1 month after gastroenterostomy?
52	Gastrojejunal ulcer, jejunitis	Transthoracic	None	100/80	40/48	Poor function gastrojejunal ulcer could not be ruled out	Return of pain 2 months P.O. diarrhea
53	Gastrojejunal ulcer	Transthoracic (elsewhere)	None		40/28	Dilated jejunal loops gastrojejunitis	Several hemorrhages, resection of stomach, large gastrojejunal ulcer

* Insulin test negative

The results in the fourteen cases in which one of us (W.W.) performed the operation without other surgical procedures on the stomach have been satisfactory so far as measured by relief of pain by reduction of gastric acidity and in general by reduction in gastric

secretion In one of these cases however (case 14 table 3) death from coronary insufficiency occurred one hour after operation Reduction in gastric acidity and night secretion in some of the cases is shown in table 3

One patient (case 3 table 3) operated on for a gastric ulcer complained of fullness after eating small amounts of food He continued to have a dilated stomach with pylorospasm retention of considerable gastric secretion and hypomotility of intestines several weeks after operation At this time the roentgenologist could not see whether the ulcer had healed because of the fluid in the stomach Unfortunately gastroscopic examination was not done but will be at the next follow up examination

In ten of our thirteen patients who survived and on whom no other operation was performed relative achlorhydria followed the operation In the other three it did not develop

In five of these thirteen cases postoperative disturbance of gastric motility occurred Three of these patients were operated on before November 1 1946 In two of these three the disturbance persisted for several weeks One of these patients has continued to complain of fullness after eating and the other of belching of foul smelling gas Both patients have retained gastric secretion with food remnants but both are free of pain and one has gained 20 pounds (9.1 kg) Of the other two of the five cases evidence of atony of stomach was found in one case and in another retained secretion and pylorospasm were noted after operation on roentgenologic examination In one of our cases (case 37 tables 5 and 9) a large gastric ulcer recurred with pain and bleeding after gastric neurectomy and biopsy of the ulcer was performed transthoracically A gastrojejunal ulcer had been removed and the anastomosis disconnected six weeks previously An insulin test showed that all the gastric nerves were sectioned Achlorhydria followed the operation but in two and a half months free hydrochloric acid reappeared in the stomach and the crater of an ulcer became visible on roentgenologic examination and the symptoms of ulcer and anemia returned After several months of treatment by means of a rigid medical regimen carried out in the hospital symptoms of ulcer still persisted and the secretion of hydrochloric acid continued Another insulin test performed at this time gave results similar to the early one but high values for both free and total acidity were found when the histamine test was carried out In this test the histamine acts directly on the gastric glands Partial gastrectomy was necessary about six months after gastric neurectomy

Relative achlorhydria also developed after operation in seven of fifteen cases of duodenal ulcer in which simultaneous gastro-enterostomy and gastric neurectomy were performed on our service and tests of acidity (table 4) have been made This incidence of achlorhydria

contrasts favorably with an incidence of 12 per cent in cases of gastro-enterostomy which one of us (WW) reported several years ago.¹⁴ In four of the remaining cases in which simultaneous gastric neurectomy and gastro-enterostomy were performed gastric acidity was reduced. In several cases in this group tests were not made before operation. In the one case in which gastric acidity was not reduced (case 27), no insulin test was carried out to confirm the completeness of neurectomy and the patient obtained only poor relief from his symptoms.

Postoperative studies of gastric motility and roentgenoscopic and roentgenographic examinations were made on approximately the fourteenth to the twentieth postoperative day in most of the cases studied (tables 3 to 6). Postoperative disturbances in gastro intestinal motility with gastric retention have occurred in fourteen of the first forty cases in which operation was performed by one of us (WW). In ten of these cases simultaneous operations were performed on the stomach.

Characteristic of three of these ten cases was intermittent paroxysmal abdominal distention which was relieved by injections of neostigmine. In one of these ten cases distention appeared on the fifth day after operation and increased during the next two days. Roentgenologic examination of the abdomen revealed what seemed to be obstruction of the small intestine and exploratory operation revealed ileus without mechanical obstruction. The small intestine was filled with fluid and air or gas and there was approximately 800 cc of sterile straw-colored fluid within the peritoneal cavity. Continuous gastric suction by an indwelling nasal suction tube relieved the distention and intestinal motility returned to about normal. Three of the ten patients had clinical symptoms of gastric retention and required intermittent drainage with a gastric tube from the fourth to the eleventh days after operation. One additional patient had gastric retention for twenty six days which required a jejunojejunostomy for relief. In a recent letter received two and a half months following the second operation this patient reported an excellent result and that he had gained 20 pounds (9.1 kg).

In one of the cases in which gastric neurectomy and gastro enterostomy were performed by our colleagues death occurred on the fourteenth postoperative day. Postmortem examination revealed that the duodenal ulcer had perforated (table 8) and an unsuspected subdiaphragmatic abscess had developed. Weeks and his associates recently reported a case in which the patient died from peritonitis the result of a perforated duodenal ulcer seven weeks following trans thoracic vagotomy and one week following splanchnic resection for hypertension. In another of our colleagues cases in which gastric neurectomy, cholecystectomy and appendectomy were performed,

the patient died after a convulsion on the fourth postoperative day. Unfortunately consent for postmortem examination could not be obtained. Another death from coronary occlusion occurred at the patient's home three months after gastric neurectomy for gastrojejunal colic fistula in which the fistula into the colon was closed at the time of operation. The gastric acids of one additional patient who had an early relative achlorhydria returned to preoperative level one month after operation and symptoms of ulcer returned. An insulin test was not done in this case.

Insulin Test—It is of course important in evaluating results of gastric neurectomy to determine whether all of the gastric (vagus)

TABLE 10

RESULT OF INSULIN TESTS IN CASE OF RECURRING
GASTRIC ULCER (CASE 37)

	Fasting	Time after Injection of Insulin Minutes			
		15	30	45	60
9 18-46					
Blood sugar mg per 100 c.c.	103	89	68	48	45
Total acid units	26	12	12	10	10
Free hydrochloric acid units	10	0	0	0	0
Amount of gastric secretion c.c.	30	10	15	35	40
1 7-47					
Blood sugar mg per 100 c.c.	105	113	72	47	35
Total acid units	26	8	10	10	10
Free hydrochloric acid units	10	0	0	0	0
Amount of gastric secretion c.c.	45	8	10	20	60

nerves have been divided. The insulin test described by Hollander is one method of determining this. It involves some risk and must be done under the constant supervision of a physician who has available a solution of glucose for immediate administration if symptoms and signs appear which indicate that hypoglycemic convulsions are im-

twenty-eight of the forty cases in which one of us (W.W.) performed gastric neurectomy the Hollander insulin test has been carried out

(tables 3 to 5) In all but two of these twenty-eight cases no elevation in gastric acidity occurred with the Hollander insulin test

COMMENT

When these results were reported at a meeting of the general staff of the Mayo Clinic on December 18, 1946 Dr Ralph Colp senior surgeon at Mount Sinai Hospital in New York, was present and discussed this paper. In doing so he described results in twenty cases in which he had performed supradiaphragmatic gastric neurectomy for peptic ulcer. Eight of his patients had been well and free of symptoms for from six to eight weeks. Four complained of pain, had hypomotility and belching of foul gas. Surgical exploration was carried out in these four cases and an active duodenal ulcer was found in one. In the other three exploration revealed evidences of gastric hypomotility but the ulcers were healed and there was no evidence of obstruction at the pylorus. In all four, subtotal gastrectomy was performed because formation of recurrent ulcer seemed less likely to follow this procedure than gastro-enterostomy and because he thought drainage of the stomach would be better. In five of the nine cases in which gastric neurectomy was done for gastrojejunal ulcers after partial gastrectomy, complete healing of the ulcer with relief of symptoms occurred in from ten to seventeen days after operation.

In Grimson's most recent report⁴ on the results of the operation in fifty seven cases he described disturbances in motility in twenty five. In six cases there was severe gastric retention which necessitated gastro-enterostomy. This gave an incidence of secondary gastro enterostomy of one among each seven patients who had not had a previous drainage operation.

Schiff of Cincinnati, Ohio, recently informed us that partial gastrectomy was necessitated seven weeks after ineffectual resection of the gastric nerves for recurring hemorrhages from an unhealed duodenal ulcer in a middle aged man. Our colleague Dr Priestley, recently performed operations for active peptic ulcers in two cases in which transthoracic gastric neurectomy had been performed previously. In one of these cases gastric neurectomy had been performed elsewhere for gastrojejunal ulcer but hemorrhage from the ulcer occurred ten hours after the operation and again several weeks later. When the anastomosis was taken down and the patient's stomach was resected an active gastrojejunal ulcer with a crater and marked jejunitis was found. In the second case he felt it necessary to perform a drainage operation of the stomach two months after transthoracic gastric neurectomy because of failure of the stomach to empty properly. As much as 500 cc of gastric secretion was removed at one time in this case before the second operation. An active duodenal ulcer was found at operation and the pylorus was patent. Anterior gastro enterostomy

was performed but retention of gastric secretions in larger amounts continued for almost a month after operation (case 48 table 6)

In such cases Colp postulated that partial gastrectomy is preferable to gastro enterostomy. He reasoned that if the stomach does not empty through an open pylorus after gastric neurectomy, it also might not empty after gastro enterostomy. In his cases when this situation was encountered therefore he has performed partial gastrectomy with good results.

The Hollander insulin test was not performed in either of Priestley's cases nor did Colp or Schiff mention whether insulin tests were performed on their cases. It seems to us however, if the results of gastric neurectomy in the treatment of peptic ulcer are to be evaluated properly (1) the presence of an ulcer should be proved by surgical examination and demonstration of the ulcer in each case (2) only cases in which vagus gastric neurectomy is performed without other surgical procedures should be considered and (3) positive evidence should be available in these cases that all of the branches of the gastric nerves have been divided. In addition in such cases tests of the quantity of night secretion and gastric acidity and postoperative roentgenologic examination should be made to determine the effects of the operation on the ulcer itself and on gastro intestinal motility.

Gastric neurectomy is not without risk for it relieves the visceral pain and the ulcer may perforate with fatal results without diagnosis being made.

SUMMARY

Experience would seem to indicate that the early results of gastric neurectomy in the treatment of duodenal ulcer without obstruction are followed by relief of pain partial atony of the stomach reduction in the quantity of night secretion and a marked diminution of gastric acidity.

Disturbances in motility of the stomach and small intestine are frequent after the operation although in most cases they are temporary. They seem to occur more frequently in the cases in which gastric neurectomy is combined with an operation on the stomach such as gastro enterostomy. In some cases they have persisted with annoying symptoms and secondary drainage operations of the stomach such as gastro enterostomy and partial gastrectomy have been required for their relief.

In the evaluation of the results of the operation it must be proved that an ulcer is present and that the gastric nerves have been completely sectioned. In addition studies of preoperative and postoperative gastric acidity should have been made and roentgenologic examination of the stomach is needed to determine the size and motility

tion of the duodenum from occurring in all individuals. It seems possible that certain deficiencies may exist in the normal resistance to the action of gastric juice exhibited by the duodenal mucosa of those in whom ulceration of the duodenum develops. It is well known, for example, that some individuals may have hyperacidity for years and yet an actual ulcer of the duodenum will not develop. Is this because their defense mechanisms are more active than are the mechanisms of those in whom ulceration occurs? Knowledge of the normal defense mechanisms is not so complete as one might desire but among the factors which are commonly considered important in this regard might be mentioned the secretion of mucus, the normal flow of bile and pancreatic juice into the duodenum, the normal vitality (adequate circulation and so forth) of the duodenal mucosa and the secretion of succus entericus. In addition, consideration must be given the normal regulatory mechanisms which ordinarily terminate that stimulation of gastric secretion which is associated with ingestion of food.

Of the other etiologic factors which should be mentioned, perhaps the most important one is a local factor. It seems apparent that there should be some reason why ulceration occurs so consistently in approximately the same portion of the duodenum, both experimentally and clinically. It seems likely that local trauma produced by direct emptying of the stomach into this portion of the duodenum as suggested by Mann some years ago, may constitute such a local factor. It is known that inflamed tissues, such as those subjected for some time to the action of dilute acids, are definitely more subject than normal tissues to ulceration as a result of trauma.

The neurogenic factor, long recognized as one of importance in the etiology of duodenal ulcer, probably acts through its effect on the gastric mucosa in general and the secretory cells of the gastric mucosa in particular. It is also possible that this factor is responsible for effects more direct than that just mentioned. Infection and local avascularity probably are of little importance in the average case.

NORMAL PHYSIOLOGY

Normally gastric secretion occurs in three phases each of which is self limited, is responsible for only a portion of the total gastric secretion associated with the ingestion of food and is blended with

sight, smell and taste as one approaches and partakes of appetizing food. Juice rich in acid and enzymes is produced during the psychic phase. This phase is abolished by section of the vagus nerves.

The second, or gastric, phase of secretion begins with the entrance of food into the stomach. Certain foods, such as proteins, cause a greater response than others, such as fats or carbohydrates. This phase is largely chemical in nature, although the mere presence of food in the stomach stimulates a small amount of secretion through mechanical means. It is commonly accepted that the stimulus to gastric secretion in this phase of the process is a humoral agent called "gastrin," produced by the prepyloric mucosa. It is known clinically that any type of gastric resection which does not include removal of the prepyloric gastric mucosa, in the treatment of duodenal ulcer, is followed by less favorable results than when this site is resected. Normally the gastric, or second, phase of secretion decreases in significance as the stomach empties. Proper motor function is thus of importance in the normal regulation of gastric secretion.

The third, or intestinal, phase of gastric secretion supervenes as food leaves the stomach and enters the intestine. This is the least powerful but probably the most prolonged phase, as it is stated that it may last from three to nine hours. Presumably during this phase certain processes are initiated which tend to terminate or, at least, to inhibit gastric secretion. Ivy and his co-workers have detected in the intestinal tract a substance which they named "enterogastrone" and in the urine another which they called "urogastrone." Clinical use of these agents in the medical treatment of duodenal ulcer is in the investigative stage at this time. Although secretion of gastric juice in the human being is said to be continuous, varying largely of course in amount, depending on existing stimuli, the amount of secretion at night is small in the normal individual.

In addition to thinking of acidity only as related to the stomach, one must consider also the hydrogen ion concentration of the duodenal contents, as obviously the duodenum is the site of ulceration. Kearney has observed that in the normal individual the pH of the duodenal contents is above 4.0, the concentration at which free acid occurs 80 per cent of the time. If the pH of the duodenal contents drops below 4.0 when the stomach empties a portion of its contents into the duodenum, it is only a matter of a few minutes until the pH returns to 4.0 or above. Such prompt regulation of the pH of the duodenal contents requires normally active neutralizing mechanisms.

As mentioned previously, stimulation of the vagus nerves causes secretion of gastric juice. These nerves appear to be motor to the wall of the stomach and inhibitory to the pylorus. In contrast, stimulation of the sympathetic nerves to the stomach causes mainly a flow of alkaline juice from the -- . . . of mucus and is low in per . . . are located in the prepyl . . . number of these glands is greatly reduced in the cardia and somewhat

decreased along the angle of the stomach on the lesser curvature. The sympathetic fibers presumably inhibit gastric motility but are motor to the pylorus.

PATHOLOGIC PHYSIOLOGY

As mentioned previously, hyperacidity is considered to be a constant forerunner of duodenal ulcer. Commonly, hyperacidity is manifested in degree of acidity, as estimated after a test meal, as well as in total amount of acid secreted in twenty-four hours. The cause of increased acidity is not fully known. Neurogenic stimuli may play a large part but likewise chemical factors, faulty neutralization and deficient regulatory mechanisms of gastric secretion may be significant. Thus, with the occurrence of gastric hypersecretion more gastric contents of a lower pH must be neutralized by the duodenum if the acidity of the duodenal contents is to be maintained at a normal value. This is not accomplished in cases of duodenal ulcer. Keamey has demonstrated that in the presence of duodenal ulcer the pH of the duodenal contents is approximately reversed from that which exists in the normal individual, namely, that 80 per cent of the time, when ulcer is present, the pH of the duodenal contents is below 4.0, the concentration at which free acid appears. When gastric contents enter the duodenum under these circumstances the pH drops well below 4.0 and, instead of returning promptly to a value of 4.0 or higher, it is slow in reaching this value. As a result, increased acidity of duodenal contents occurs which predisposes to the development of an ulcer and militates against its healing once it is present. Medical measures normally are directed toward reducing this duodenal acidity, and such treatment may be sufficiently effective to result in healing. If, however, these measures are discontinued and the same factors are present which initially caused the augmented acidity, ulceration may occur. Certain surgical procedures may decrease the acidity of the duodenal contents by a mechanical and, therefore, more lasting method, however, simultaneous increase in acidity of the jejunal contents usually occurs if gastrojejunal anastomosis is established and secretion of free acid persists in the stomach.

Motor function of the stomach may become altered slightly or markedly when a duodenal ulcer develops. Increased tone in the prepyloric portion of the stomach is a common roentgenologic observation and increased muscular irritability is a frequent occurrence. Delayed emptying of the stomach may be caused by inflammatory reaction in the region of the lesion or by actual sclerotic obstruction of the duodenum. It is remarkable at times how the gastric musculature will continue to contract and secrete, even though the duodenal outflow is obstructed.

tomatic evidence and may be detected only by roentgenologic means or by use of a test meal for motor function. Failure of the stomach to empty properly may be intermittent. The chronically obstructed stomach often becomes large and the surgeon in planning any operation should anticipate its return to normal size after relief of obstruction.

INDICATIONS FOR SURGICAL TREATMENT

It is generally agreed that medical treatment should be instituted in all cases of duodenal ulcer except those in which certain complications are present. Our experience at the Mayo Clinic indicates that approximately 85 per cent of all patients with this condition can be treated medically. Complications which are considered to indicate the desirability of surgical treatment and which will be discussed only briefly may be listed as primary or secondary. In the former group are included hemorrhage, obstruction, perforation, failure of medical management and any doubt as to the benignity of the lesion.

Hemorrhage may present itself either in the form of active, acute, massive hemorrhage or as a history of recurrent hemorrhages without active bleeding at the time the patient is examined. Opinion differs as to the type of treatment advisable for acute massive hemorrhage. In the past treatment was always conservative but in recent years some surgeons have favored emergency surgical treatment. In general it may be stated that the majority of patients who have massive hemorrhage from duodenal ulcer and are less than forty-five years of age respond favorably to medical management. On the contrary the risk of medical management is increased definitely in the group of patients who are more than forty-five years of age. At present it is our practice to institute medical treatment in all cases in which massive bleeding from duodenal ulcer occurs. If after medical treatment has been continued for forty-eight hours there is still evidence of continued or recurrent bleeding it is our opinion that immediate surgical intervention is desirable. In other words the patient is given an opportunity to respond to medical treatment but if the response is not favorable in forty-eight hours we believe that there should be no further delay in surgical treatment.

For the patient who has had several episodes of bleeding one is always a little more inclined to suggest surgical treatment. This is especially true if bleeding occurs under ordinary circumstances when the patient has been taking at least fairly good care of himself. Medical treatment which failed to prevent hemorrhages in the past hardly can be considered adequate to prevent hemorrhage in the future.

Obstructive lesions caused by duodenal ulcer may be either inflammatory or sclerotic in nature. The inflammatory type of obstructive lesion usually is seen during a subacute exacerbation of symptoms.

Under proper medical treatment, symptoms of obstruction generally disappear in a week or ten days. It is doubtful, however, whether more than one or two such episodes should be treated medically because they are likely to recur and cause sclerotic narrowing of the duodenum. When a definite cicatricial type of obstructive lesion results, the problem becomes largely mechanical in nature, then there is little to offer but surgical treatment.

Perforation by a duodenal ulcer may be either a subacute or an acute process. All agree that acute perforation of a duodenal ulcer constitutes a surgical emergency. The subacute perforating duodenal ulcer generally is one of pronounced activity, causing varying degrees of penetration through the wall of the duodenum. In the advanced case the entire thickness of the duodenal wall has been eroded and the base of the crater consists of adjacent tissue, usually pancreas. When an ulcer of such pronounced activity is present it is unlikely that medical management will result in satisfactory cure.

Failure of medical management to relieve symptoms of ulcer long has constituted an indication for surgical treatment. Care must be exercised, however, in determining just when failure of medical management has occurred. One should be confident that an adequate regimen has been followed.

Occasionally uncertainty will exist regarding the exact diagnosis in a case of duodenal ulcer. This occurs most often when the lesion is situated at the pylorus and the roentgenologist is unable to say whether it is actually in the duodenum or on the gastric side of the pylorus. A small carcinoma in this vicinity may closely simulate a duodenal ulcer. If any doubt exists as to the benignity of the lesion a surgical exploration should be advised. Thus, if an obstructing lesion at the outlet of the stomach is thought to be a duodenal ulcer, but if the gastric acidity is low and perhaps free hydrochloric acid is absent, exploration should be performed.

Besides these primary indications for surgical treatment of duodenal ulcer, there are certain factors of secondary importance, the presence of which tends to favor surgical intervention. These include a very unfavorable economic status which virtually prevents the patient from making adequate trial of medical management, the unco-operative nature of a given patient whereby the dietary regimen is not followed, excessive gastric acidity with a value of free hydrochloric acid possibly of 80 or more (Topfer's method), a history of duration for many years and symptoms of marked severity. While no one of these secondary factors alone should be considered to constitute a definite indication for operation when two or more of them exist in the same case, thought should be given to the advisability of operation.

GASTRO ENTEROSTOMY

Physiologic Considerations—Complete diversion of the gastric contents from the duodenum by a satisfactorily functioning gastro enteric stoma results in marked change in the pH of the duodenal contents. Under these circumstances the duodenal contents constantly are neutral or alkaline and therefore the duodenal ulcer heals in virtually every case. Unfortunately however the amount of gastric secretion is not reduced by this operation only the site at which it enters the intestine is changed from the duodenum to the jejunum. The beneficial factor from the viewpoint of neutralization or dilution of the gastric contents is that most of the duodenal juices pass either into the stomach or directly along the jejunum where it is joined to the stomach provided a short jejunal loop has been used in making the anastomosis. Undoubtedly this behavior of duodenal juices constitutes a factor of importance in the prevention of jejunal ulceration. When an ulcer develops after gastro enterostomy it almost always occurs in the distal loop of jejunum in proximity to the stomach. At this site probably the greatest trauma from gastric emptying and the highest acidity occur.

In addition to changing the acidity of the duodenal and jejunal contents gastro enterostomy alters the motor function of the stomach in that it permits satisfactory emptying of the stomach despite obstruction in the first portion of the duodenum. Thus existing duodenal obstruction is eliminated as a factor of significance.

Indications—Although one hears many words of condemnation for gastro enterostomy it cannot be denied that many patients have experienced an eminently satisfactory result after this operation. It seems that this fact should be kept in mind because if this operation is performed with proper indication and its technical execution is correct good results still may be expected in a large majority of cases. True the possibility of occurrence of jejunal ulcer always remains, but that possibility also exists to a less extent after gastric resection. It should be remembered that in the hands of the average surgeon gastro-enterostomy entails a definitely lower operative risk than does gastric resection.

Gastro-enterostomy may at times be one of expediency category would be as a poor surgical risk. would have a chronic lesion of long standing perhaps causing obstruction because of sclerotic changes would have relatively low gastric acidity would present a single lesion and no appreciable associated gastritis and would exhibit a minimal neurogenic factor. At times gastrojejunostomy may be employed in the absence of many of the conditions just mentioned if the technical aspects of gastric resection involve too great difficulty or hazard.

Such may be the case in dealing with an ulcer deeply placed in a shortened duodenum which permits neither removal of the ulcer and satisfactory closure of the duodenal stump without jeopardizing the common bile duct nor section of the duodenum immediately distal to the pylorus and satisfactory closure of the duodenal stump. This

than the surgical procedure of theoretic choice. As the surgeon's experience increases, technical considerations of this type become less of a factor in his choice of operative procedure.

Technical Considerations.—The many technical details involved in the establishment of a gastro enteric stoma will not be discussed, but only a few points will be mentioned which seem of particular importance for the satisfactory postoperative function of gastrojejunal anastomosis. Likewise, only one type of gastrojejunostomy will be considered.

The placing of the stoma is important. It should be neither too proximal nor too distal in the stomach, neither should it be too high nor too small. While there is more than one way of making a gastro jejunal stoma that will permit satisfactory gastric motor function, the preferred type is as follows. The stoma is placed on the posterior wall of the stomach and is extended almost from the lesser curvature down to the greater curvature in a line running approximately from the patient's right shoulder to his left foot, with the proximal jejunal loop fixed to the lesser curvature of the stomach and the distal loop joined to the greater curvature. The point at which the distal jejunal loop is attached to the greater curvature of the stomach should be directly below the angle of the lesser curvature. One should remember that an enlarged, obstructed stomach will decrease in size after relief of the obstruction with corresponding decrease in size of the gastro enteric stoma. Two or three rows of sutures may be used. Fine suture material is preferred. The stoma in the jejunum should be placed directly opposite the mesenteric border. Less than 0.5 cm. of stomach or jejunum should be inverted into the gastro enteric lumen, particularly at the point at which the distal loop of jejunum leaves the stomach.

The retrocolic type of anastomosis is preferred. The transverse mesocolon should be sutured to the gastric wall at least 2 cm. removed from the site of anastomosis around the entire stoma. The surgeon must be certain that these sutures actually are placed in the gastric wall in the region of the greater curvature and not in the gastrocolic omentum. This requires that several sutures be passed through the gastrocolic omentum and into the anterior gastric wall at the lower angle of the anastomosis. A short proximal jejunal loop should be used.

one just short enough, perhaps 8 to 10 cm in length, to permit approximation of the jejunum to the lesser curvature of the stomach without tension, yet without appreciable redundancy. At the conclusion of the operation the distal loop of jejunum should be placed so that it lies to the patient's left in the region of the root of its mesentery.

GASTRIC RESECTION

Physiologic Considerations.—The primary purpose of all types of gastric resection performed for duodenal ulcer is to eliminate the factor of acidity in the genesis of ulcer by removal of a major portion of the acid secreting gastric mucosa. This involves simultaneous eradication of most of the gastric ferments and of a large part (two thirds to four fifths) of the stomach, with resultant decrease in capacity of the stomach as well as decrease in the gastric phase of digestion and anatomic which results in digestive symptoms.

The emptying time of the stomach is decreased, which may cause symptoms, and food is permitted to enter the small intestine, duodenum or jejunum, as the case may be without the normal amount of preliminary change. If gastrojejunal anastomosis is established, as is the common practice, the amount of the digestive juices which normally are secreted and excreted into the duodenum may be decreased as has been suggested by Wangenstein and studied by Kolouch.

After restoration of gastro intestinal continuity by gastrojejunal anastomosis the pH of the duodenal contents remains neutral or alkaline and the duodenal ulcer heals in all cases if, for any reason, it is not removed, however, the ulcer almost always is removed at the time of resection. The subsequent danger then, as with gastroenterostomy, is the possibility of jejunal ulceration. This, of course, occurs infrequently if the amount of stomach removed is adequate to eliminate free hydrochloric acid from the gastric contents.

The most physiologic type of resection, and the one which I prefer and use whenever feasible, is the Billroth I type. In this procedure the stomach is rejoined to the duodenum after gastric resection. Physiologically this procedure is sounder than certain others in that it permits food to pass from the stomach to the duodenum as it normally does although the food is not prepared as completely before entering the duodenum as it was prior to operation. One may anticipate, however, virtually normal stimulation of pancreatic and biliary secretory activity. Obviously a jejunal ulcer cannot occur at the site of anastomosis, should ulcer occur in the duodenum the patient is no worse off than he was prior to operation. Resection, with anastomosis

Such may be the case in dealing with an ulcer deeply placed in a shortened duodenum which permits neither removal of the ulcer and satisfactory closure of the duodenal stump without jeopardizing the common bile duct nor section of the duodenum immediately distal to the pylorus and satisfactory closure of the duodenal stump. This type of lesion is usually associated with a large stomach and deeply

arduous and

than the surgical procedure of theoretic choice. As the surgeon's experience increases, technical considerations of this type become less of a factor in his choice of operative procedure.

Technical Considerations.—The many technical details involved in the establishment of a gastro-enteric stoma will not be discussed but only a few points will be mentioned which seem of particular importance for the satisfactory postoperative function of gastrojejunal anastomosis. Likewise only one type of gastrojejunostomy will be considered.

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The emptying time of the stomach is decreased, which may cause symptoms, and food is permitted to enter the small intestine, duodenum or jejunum, as the case may be, without the normal amount of preliminary change. If gastrojejunal anastomosis is established, as is the common practice, the amount of the digestive juices which normally are secreted and excreted into the duodenum may be decreased, as has been suggested by Wangensteen and studied by Kolouch.

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of this type is simpler to perform and entails fewer suture lines than a Billroth II type of operation. Likewise motor function is uniformly satisfactory and the so called dumping syndrome does not occur. The pH of the duodenal contents is elevated because of reduction in the gastric secretory surface and consequently recurrent duodenal ulceration is unlikely.

Indications—Indications for gastric resection will vary with ones current opinion regarding the indications for vagotomy. My view regarding vagotomy is conservative at the present time for reasons that will appear later.

Until vagotomy has had time to prove itself, therefore gastric resection probably should be used in approximately five out of six cases of duodenal ulcer at least in the type of cases seen in my experience. It is apparent from previous remarks that resection is not considered an ideal procedure for treatment of duodenal ulcer and it is possible that as time passes this procedure may be supplanted gradually by one or more forms of medical or surgical treatment. At present the ideal patient for gastric resection would be a man of middle age in good general condition who had failed to obtain relief despite careful and prolonged adherence to a medical regimen whose gastric acidity was high who perhaps had experienced recurrent hemorrhages and who had an active lesion for which resection would not be unduly difficult or hazardous. The presence of multiple ulcers and associated gastritis as well as of a large neurogenic element would favor resection rather than conservative operation however

type

preference is for the Shoemaker modification of the Billroth I type in which resection of the stomach is carried higher along the lesser curvature than the greater curvature and the end of the stomach, after closure of the lesser curvature to the desired point is anastomosed directly with the end of the duodenum. To accomplish this operation one must have an adequate amount of duodenum distal to the ulcer that can be mobilized with a good blood supply. Anastomosis must be accomplished without tension and without limitation of resection of the desired amount of stomach. The end of the gastric stump is so formed by appropriate closure of the lesser curvature that its size corresponds with that of the duodenum. The amount of stomach and duodenum inserted into the gastroduodenal stoma should be small in order that an adequate gastric outlet may be maintained. Although crushing clamps may be used my preference is for the so called open anastomosis performed by the use of rubber-covered Doyen forceps.

In a Billroth II type of resection it has been well demonstrated that short loop retrocolic anastomosis is followed by results superior to

those obtained when long loop antecolic anastomosis is employed although some surgeons advocate the latter type. This latter type which is technically easier to perform at times may be used for expediency if the patient is fat the transverse colon short and thick and the stomach is small and in a high position. Entero anastomosis between the jejunal loops is unnecessary and undesirable. One may anastomose the entire end of the stomach with the jejunum or only a part of it after closure of the portion bordering the lesser curvature according to the method of Hofmeister the latter procedure is the favored one. None of the prepyloric portion of the stomach should be permitted to remain. Removal of the duodenal ulcer itself is unnecessary although some state otherwise so long as satisfactory closure of the duodenal stump is obtained. In practice the ulcer is removed almost invariably. Satisfactory closure of the duodenal stump is most important. Likewise it is essential that there be no angulation or other factor which might interfere with free emptying of the proximal jejunal loop as increased intraluminal duodenal pressure predisposes to leakage from the duodenal stump. The same technical points discussed in connection with gastro enterostomy apply in establishing gastrojejunal anastomosis after gastric resection namely approximation of the jejunum and the stomach direction of jejunal loops length of proximal jejunal loop suturing the transverse mesocolon well back from the anastomosis and so forth.

VAGOTOMY

Physiologic Aspects—Complete section of the vagus nerves abolishes the psychic phase of gastric secretion and other neurogenic influences on the gastric mucosa. As a result the amount of gastric secretion (gastric enzymes as well as acid) and degree of acidity of the gastric juice are decreased. Usually vagotomy does not result in an acidity or complete absence of free hydrochloric acid because the activity of the gastric and intestinal phases of gastric secretion persist. Nevertheless reduction in amount of gastric secretion and in degree of acidity is definite. Lester Dragstedt who has been largely responsible for the present day clinical use of bilateral vagotomy in the treatment of duodenal ulcer emphasizes the marked reduction in night secretion which occurs after this operation. Simultaneously there is a decrease in the motor function of the stomach. This may be manifest clinically provided gastro enterostomy is not performed simultaneously by gastric retention in certain cases in which there were no symptoms of even in some cases in which a gastric retention may occur oratory gastric retention (years) results will be on the human stomach from a secretory point of view as well as

of this type, is simpler to perform and entails fewer suture lines than a Billroth II type of operation. Likewise motor function is uniformly satisfactory and the so-called dumping syndrome does not occur. The pH of the duodenal contents is elevated because of reduction in the gastric secretory surface and, consequently, recurrent duodenal ulceration is unlikely.

Indications.—Indications for gastric resection will vary with one's current opinion regarding the indications for vagotomy. My view regarding vagotomy is conservative at the present time, for reasons that will appear later.

Until vagotomy has had time to prove itself, therefore, gastric resection probably should be used in approximately five out of six cases of duodenal ulcer, at least in the type of cases seen in my experience. It is apparent from previous remarks that resection is not considered an ideal procedure for treatment of duodenal ulcer and it is possible that as time passes this procedure may be supplanted gradually by one or more forms of medical or surgical treatment. At present the ideal patient for gastric resection would be a man of middle age, in good general condition, who had failed to obtain relief despite careful and prolonged adherence to a medical regimen, whose gastric acidity was high, who perhaps had experienced recurrent hemorrhages and who had an active lesion for which resection would not be unduly difficult or hazardous. The presence of multiple ulcers and associated gastritis, as well as of a large neurogenic element, would favor resection rather than conservative operation, however, none of these factors makes for

type

preference is for the Shoemaker modification of the Billroth I type, in which resection of the stomach is carried higher along the lesser curvature than the greater curvature and the end of the stomach, after closure of the lesser curvature to the desired point, is anastomosed directly with the end of the duodenum. To accomplish this operation one must have an adequate amount of duodenum distal to the ulcer that can be mobilized with a good blood supply. Anastomosis must be accomplished without tension and without limitation of resection of the desired amount of stomach. The end of the gastric stump is so formed by appropriate closure of the lesser curvature that its size corresponds with that of the duodenum. The amount of stomach and duodenum inserted into the gastroduodenal stoma should be small in order that an adequate gastric outlet may be maintained. Although crushing clamps may be used, my preference is for the so called open anastomosis performed by the use of rubber-covered Doyen forceps.

In a Billroth II type of resection it has been well demonstrated that short loop, retrocolic anastomosis is followed by results superior to

tion even though extensive may be followed by formation of jejunal ulcer. In general then, I believe that at this time the operation should be reserved for the exceptional type of patient who has duodenal ulcer. In contrast, indications for vagotomy in the treatment of jejunal ulcer are perhaps wider, however, this is not the type of lesion under discussion.

Gastric retention may occur after transthoracic vagotomy performed for duodenal ulcer, even though preoperatively there was no indication of gastric obstruction as shown by clinical or laboratory investigation. Such retention may be severe enough to require gastroenterostomy. Because of this fact transthoracic vagotomy seldom seems indicated in the treatment of duodenal ulcer. If this viewpoint is accepted transabdominal vagotomy performed in association with gastroenterostomy would constitute the alternative and more desirable procedure. Evaluation of late results of this method of treatment will require the lapse of a number of years. The abdominal approach presents the advantage of permitting direct examination of the lesion and exploration of the entire abdomen. It has the disadvantage until the surgeon has gained considerable experience, of making complete resection of all branches of the vagus nerves somewhat less certain.

Technical Aspects—A prerequisite to the performance of vagotomy is accurate knowledge of the anatomic location and distribution of the fibers of the vagus nerves both above and below the diaphragm. Failure to section all fibers of these nerves can lead only to confusion and unsatisfactory results.

If a transthoracic approach is employed resection of a generous portion of the left eighth rib affords fine exposure. Occurrence of a pathologic process previously in the left side of the thorax adds to the difficulties and in certain cases, may make a right sided approach more desirable. A generous portion (preferably 3 cm. at least) of each vagus nerve should be resected and an effort made to prevent realignment of the nerve ends should regeneration occur.

In the abdominal approach a left sided incision although it is not essential aids in obtaining good exposure of the esophagus. Several inches of esophagus should be cleared and extreme care exercised to perform wide resection of all branches of the vagus nerves. A soft rubber catheter, or a strip of gauze on which caudal traction is made after it is looped around the esophagogastric junction is helpful in obtaining adequate mobilization and exposure of the esophagus. Mobilization adequate to permit rotation of the esophagus in an arc of at least 180 degrees is essential. All tissue removed should be examined microscopically to aid in the thoroughness of the operation and in the ready recognition of the fibers of the vagus nerves.

from that of motor function is not known and this fact in my opinion constitutes one of the chief reasons why bilateral vagotomy should not be performed in a widespread manner at present. For example it takes some few years as a rule for Hirschsprung's disease to cause pronounced enlargement of the colon. In a certain percentage of dogs subjected to bilateral transthoracic vagotomy there has been a return of gastric acidity to its preoperative value five years after operation and in addition some of the animals have had a greatly dilated atonic stomach at that postoperative date. The early (two to three years) postoperative results in human beings apparently have been satisfactory in numerous cases; however in some cases they have not been good.

The vagus nerves do not supply sensory fibers to the stomach as is evidenced by the fact that intragastric distention after bilateral vagotomy causes distress. The importance of vagal stimuli to the motor function of the remaining portion of the intestinal tract is not completely understood. From the standpoint of immediate clinical results vagal stimuli do not appear to be too important. Likewise the significance of vagal stimuli to the secretory and excretory functions of the accessory glands of digestion is not completely known but apparently such stimuli are not essential according to impressions gained from observations in early postoperative clinical cases.

Indications.—At present probably no two gastric surgeons would offer an identical group of indications for vagotomy in the treatment of duodenal ulcer. One's selection of patients for vagotomy depends as mentioned previously on the degree of one's current acceptance of this procedure for use routinely in the surgical management of duodenal ulcer. As mentioned previously my opinion is conservative as I believe it at this operation although promising should prove it self over a period of five to ten years before it is permitted to replace old and tried methods which it is known will give good results in a high percentage of cases. The work of Dragstedt is outstanding. I believe that the operation should be proved in hands such as his rather than by a large number of isolated surgeons over the country who of necessity will have fewer and less well controlled cases.

With this preamble it is apparent that at this time I can present only my personal viewpoint regarding the indications for vagotomy and that these views should not be misinterpreted as facts. In general I have considered the operation indicated if there is nothing else to offer the patient which can give a high assurance of a good result. Thus in the case of a man twenty years of age perhaps of Jewish extraction who is extremely nervous and who suffers from excessive gastric acidity and long standing symptoms so severe that almost constant hospitalization is required bilateral vagotomy may be a proper procedure. It is known that in this type of case gastric resec-

MULTIPLE SIMULTANEOUS CARCINOMAS OF THE STOMACH TREATED BY TOTAL GASTRECTOMY REPORT OF A CASE

CLAUDE F. DIXON AND RODGER E. WEISMANN

IN contrast to the relative frequency of incidence of primary single carcinoma of the stomach multiple simultaneous lesions of that organ are apparently rare. Schneider in 1940 found twenty five reported cases of simultaneous multiple carcinomas of the stomach in a review of the literature between 1887 and 1940. After critical analysis of the published reports he omitted sixteen cases because of lack of detail but in making his report Schneider added a case of his own which made a total of ten authenticated cases. In 1941 Sanders reported an additional case in which the patient was treated by subtotal gastrectomy. Brindley, Dockerty and Gray reported an additional case. They also reviewed the literature and found thirty six cases in which multiple primary carcinomas (or malignant lesions) were present in the stomach. These constituted 3.4 per cent of all reported cases of multiple neoplastic processes in the entire body.

In a recent survey of the records and pathologic material at the Mayo Clinic Hansbro found thirty four cases in which the simultaneous occurrence of multiple primary carcinomas of the stomach had been proved by histologic examination.

The increased range of resectability of malignant lesions of the stomach by the use of more radical extirpation procedures such as total gastrectomy by either the subdiaphragmatic or transthoracic approach and the successful excision of adjacent structures potentially or actually involved by extension of the malignant process now make such surgical treatment available to patients with carcinomatous involvement of the stomach. Rickles in 1946 reported an additional case of multiple primary carcinomas of the stomach in which there was extensive involvement of the distal portion of the esophagus. He was able to complete the resection by a two stage operation the second was employed to complete the total resection and esophagojejunal anastomosis by the supradiaphragmatic route.

REPORT OF CASE

A man aged forty four years who worked in an oil field registered at the Clinic January 18, 1947. His chief complaint was epigastric burning pain of one year's duration and loss of appetite of two weeks' duration. The nonradiating epigastric pain occurred about an hour after eating or drinking and seemingly had no relationship to the type of food taken. It lasted from a few minutes to an hour and could be partially relieved by belching. The pain occasionally awakened him at night. No nausea, vomiting, jaundice, colic or tarry stools had occurred. His

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to be involved by a neoplastic lesion which did not appear to have invaded the esophagus. The liver, parietal peritoneum, omentum and other structures were free of gross evidence of metastasis. Total gastrectomy was performed together with removal of a considerable portion of gastrohepatic and gastrocolic omentum. A loop of jejunum was then anastomosed in a retrocolic position to a small fringe of cardia and esophagus by using an outer row of silk sutures and two inner rows of chromic catgut sutures (end-to-side, posterior Polya type of anastomosis). The spleen was removed in the course of the operation. Ten grams of sulfathiazole and 100,000 units of penicillin were placed in the abdomen. The wound was closed in layers by using a double continuous suture of chromic catgut supplemented by interrupted sutures of fine silk in the fascia. During the operation, the patient received 1,000 c.c. of whole blood.

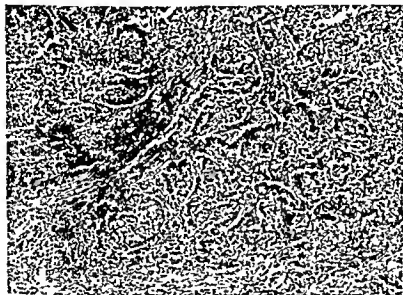


Fig 298—Section of largest tumor on the lesser curvature, adenocarcinoma, grade 3 ($\times 100$)

The pathologist reported as follows: "Ten centimeters above the pylorus, forming a ring around the stomach, there are three apparently independent primary adenocarcinomas. The largest of these is a sessile type of grade 3 polypoid growth, 5 by 4 by 3 cm, which saddles the lesser curvature. The other two lesions were 4 by 4 by 2 cm each, one being located on the posterior and one on the anterior wall. Each of the lesions had invaded the submucosa and the peritoneum. The largest lesion had also invaded the spleen." (Figs 299 and 300)

The postoperative course was unremarkable.

100% survival at 9 months.

no further treatment.

appetite had been good until two weeks before he came to the Clinic. At that time, roentgenoscopic examination and roentgenologic studies of his stomach had disclosed carcinoma of the stomach and he had been referred to the Clinic for further care.

The family history was unimportant and the patient's past history did not contain significant information relative to the present illness. He had lost 18 pounds



Fig 297—Resected portion of stomach containing three separate sessile ulcerating carcinomatous masses which form a ring about the upper segment of the organ.

could be detected. The erythrocytes and leukocytes numbered 5,130,000 and 6,400

ings each of which did not exceed 200 c.c. in volume. During the remaining period of hospitalization the diet was gradually increased quantitatively and qualitatively and during the last five days the daily intake was between 1700 and 2500 calories. On the fifth postoperative day the value for the hemoglobin was 10.75 gm per 100 c.c. of blood and the erythrocyte count was 3,680,000. On the next day the value for the blood urea was 26 mg per 100 c.c. the value for the chlorides was 587 mg per 100 c.c. of plasma the carbon dioxide combining power 44.7 volumes per 100 c.c. of plasma the value for the serum protein was 5.8 gm per 100 c.c. and the albumin globulin ratio was 2.04:1.

The patient was released from the hospital on the fifteenth postoperative day. At that time he preferred to take three relatively large meals a day. Before the operation he weighed 145 pounds (65.8 kg). On the fourteenth postoperative day he weighed 138 pounds (62.6 kg). When he was dismissed from the Clinic on February 20, 1947 (the twenty-second postoperative day) he weighed 138 pounds (62.6 kg). He was tolerating his diet well and had no significant digestive disturbance. He was advised to increase gradually both the quality and quantity of nourishment and to supplement this by the use of iron therapy and by taking one capsule of multicebrin daily.

COMMENT

The specimen was interesting from a pathologic standpoint in that the three lesions were situated in a ring about the upper segment of the stomach. The factors responsible for development of the lesions appeared to have acted upon an isolated portion of the organ but there was no clue as to which of the lesions had occurred first or whether one or all arose from pre-existing localized processes such as adenomatous polyps or simple ulcers. As far as could be determined the grade 3 lesion had not yet metastasized. When the stomach was explored the extent of the neoplastic process of the upper part of the stomach was not evident. Gentle external palpation of the organ had not suggested the presence of multiple neoplasms. The multiple neoplasms were not discovered until the pathologist examined the specimen.

Total gastrectomy seemed feasible because of the patient's age and good general condition. With the exception of the involvement of the regional lymph nodes in the gastrohepatic ligament, there was no demonstrable metastasis.

by Lahey and Marshall combining splenectomy with total gastrectomy, as was done in this case is advantageous. A retrocolic anastomosis of the posterior Polya type was possible and was attained because of the amount of esophagus available.

The type of incision employed in this case is the one that the senior author most frequently uses for operation on the vagus nerves, stomach, spleen and splenic flexure of the colon. It has proved advantageous in obtaining exposure of the cardia and other structures deeply situated in the left upper quadrant of the abdomen. This oblique

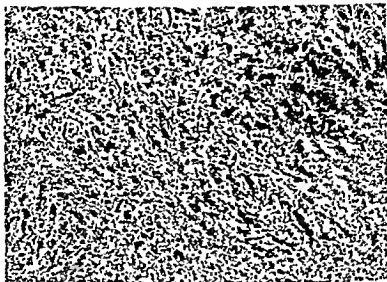


Fig 299—Section of lesion on anterior wall, adenocarcinoma, grade 4 ($\times 100$)



Fig 300—Section of lesion on posterior wall, adenocarcinoma, grade 4 ($\times 100$)

total resection of the stomach Follow up studies now are being made in cases of multiple carcinomas observed at the Clinic and these studies may yield data on which to base an estimate of the life expectancy of patients with this unfortunate affliction

SUMMARY

This paper is based on a case of multiple simultaneous primary carcinomas of the stomach in which total gastrectomy was employed Multiplicity of carcinomatous lesions of the stomach apparently occurs rarely The incidence is sufficiently high to suggest that factors other than mere coincidence should be considered Further observations will determine the advisability of performing total gastrectomy when feasible, in cases in which multiple carcinomas of the stomach are encountered

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upper abdominal incision is followed by less postoperative discomfort than is a longitudinal incision. Postoperative separation of the wound or ventral hernia has not been observed in cases in which we have employed this extensive oblique incision.

Postoperative readjustment was remarkably uneventful and the patient was dismissed from our care with instructions to observe a

maintain his weight.

In three of the previous cases of multiple carcinomas of the stomach observed at the Clinic, the patients were treated by total gastric resection. None of them survived the immediate postoperative period; all died of complications of the procedures. Total gastrectomy in the past has entailed a high postoperative risk. In a recent series of cases, however, considerable decrease in the hospital mortality was observed by Longmire, who reported a mortality rate of 10 per cent in twenty cases. With the help of recently introduced adjuncts to surgical care, it appears that total gastric resection may be employed with a lower hospital mortality rate than that formerly observed. This extensive operation can be justified on the basis of the seriousness of the disease.

subtotal gastrectomy would not provide a reasonable chance of cure. It is probable that multiplicity of lesions has more significance than mere coincidence. The multicentric origin of neoplastic change² under the influence of carcinogenic factors is strongly suggested in instances in which multiple separate carcinomas are encountered. In addition, the presence of multiple carcinomatous lesions in an organ suggests a relatively increased predisposition for neoplastic disease. Since carcinogenic agents for stomach lesions are not clearly identifiable in most, if not all cases, total resection may come to be the treatment of choice for patients with resectable multiple primary carcinomas. If subtotal resection is performed in the presence of multiple simultaneous neoplasms, the need of careful and frequent postoperative observation is obvious.

The prognosis for patients who have survived resection of the stomach for multiple primary carcinomatous processes obviously is guarded. Sanders expressed the opinion, however, that multiplicity of lesions does not necessarily influence the prognosis unfavorably and that the life expectancy depends on the type of growth, extent of metastasis, and success in resecting lesions just as is true with respect to malignant processes occurring elsewhere in the body. In the case which he reported, the patient was living fifteen months after sub

in the blood during the long incubation period of sixty to 120 days. After recovery from infection with this virus a person usually is resistant to reinfection with the same virus for a period of eighteen months or more but is perhaps more susceptible to infection with the virus of infectious hepatitis.

The blood of patients with this disease is very infective. Apparently the size of the inoculum has no effect on the duration of the incubation period or the severity of the illness. As small amounts as 0.01 cc of the infective serum is capable of transmitting the disease if administered parenterally. The virus was found circulating in the blood of one recipient thirty-four days after inoculation and sixty days before the appearance of the icterus but had disappeared two months after the appearance of icterus.⁷ It is probable even that certain persons may at times carry this agent in the blood stream without ever presenting clinical manifestations of acute hepatitis. This contention is supported by the fact that plasma pools known to contain the virus have been made up from donors who gave no history suggestive of previous hepatitis and who subsequently have exhibited no signs of the disease during a prolonged follow-up study.⁸

Present data suggest that the principal source of this virus is blood or blood products and that transmission usually occurs as a result of the parenteral introduction of such materials. Obviously blood or plasma is always suspect and even use of improperly sterilized needles or syringes may be methods of transmission.²

The clinical manifestations of serum hepatitis have been well described elsewhere in detail¹⁰ and do not warrant much discussion here except in differential diagnosis. Clinically, serum hepatitis may be indistinguishable from infectious hepatitis, usually the onset of serum hepatitis is not accompanied by abrupt fever (seldom over 100° F) but is insidious with some anorexia and malaise and a gradually developing, painless icterus. However, symptoms in the preicteric, icteric or convalescent stage may vary and frequently do, in individual cases. In some cases the symptoms may be mild, with no evidence of icterus, while in others the disease may be fulminant and the patients die within two days of onset of jaundice.

Unfortunately, there is no specific diagnostic test for these diseases. Since blood or its products are commonly administered to persons more than forty years of age, serum hepatitis is more common in the higher age groups, whereas infectious hepatitis is more common in the younger age groups. The differential diagnosis of jaundice in any age group has always been difficult and now with the added possibility of serum hepatitis the difficulty at times is even increased. The major fundamental problem, however, of distinguishing between obstructive and nonobstructive jaundice still remains. The decision as to whether or not surgical exploration should be performed in a case of jaundice

PROBLEMS ENCOUNTERED IN THE DIAGNOSIS OF SERUM- AND INFECTIOUS HEPATITIS

HUGH R. BUTT AND ARCHIE H. BACGENSTOSS

ALTHOUGH the syndrome called "infectious hepatitis" or "catarrhal jaundice" has long been known to the medical profession, it was not until the beginning of World War II that general knowledge of the disease termed "serum hepatitis" or "homologous serum jaundice," became available. In fact, most of the fundamental knowledge of these two syndromes has developed during the last four or five years.

It is now fairly well established through studies on man that infectious hepatitis is caused by a virus and that it can be transmitted to man by ingestion of infected feces or serum or by parenteral administration of infected blood or serum. Usually the interval between the oral administration of the virus and the acute onset of hepatitis varies from fifteen to forty days. The incidence of the disease is greatest between the ages of ten and twenty-five years but the disease can occur at any age. The onset usually is abrupt with fever, and the clinical symptoms and diagnosis have been well described in several current articles.¹⁻⁴

Undoubtedly, cases of serum hepatitis also have occurred for many years but it was only ten years ago that known cases in man were first reported.⁵ Sporadic cases continued to be reported but it was not until blood and blood products were given on a large scale that a sufficient number of cases occurred to cause the condition to be recognized as a definite entity. The so-called postvaccinal jaundice which developed in some 23,000 men after yellow fever vaccination in the American armed forces first brought to attention the importance of this disease.¹¹ The possibility that this syndrome was infectious in origin was suspected early³ but because the disease could not be transmitted to animals studies had to be carried out on man.

That the virus causing serum hepatitis was different from the virus causing infectious hepatitis was suspected because of the marked difference in the length of incubation periods.¹² It was noted that the incubation period of certain batches of blood or serum was 10 to 150 days after inoculation,

that it was not present in the feces nor could it be transmitted except by parenteral administration, the virus was, however, actively present

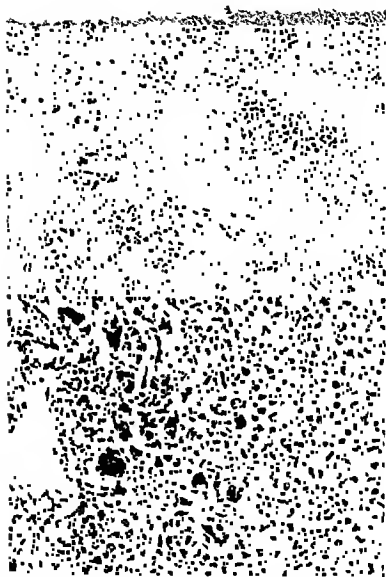


Fig 301 (Case 1) —Liver in homologous serum hepatitis. Symptoms of five days' duration. *a*, Massive destruction of hepatic parenchyma particularly in the central portions of the lobules (hematoxylin and eosin $\times 40$). *b*, Endophlebitis of portal venule. Erythrocytes, phagocytes and lymphocytes occupy the spaces which formerly contained hepatic cells. The remaining hepatic cells are atrophied (hematoxylin and eosin $\times 200$).

is still all important. Recently we have encountered several obvious and two fatal cases of serum hepatitis as well as one fatal case of infectious hepatitis in which the differential diagnosis brought forth some interesting problems.

REPORT OF CASES

CASE 1—A male farmer fifty three years old had been seen at the Clinic on many previous visits because of a disease unrelated to hepatitis. In May 1946 he was seen because of a reactivated penetrating duodenal ulcer with some obstruction. On May 13, 1946, posterior gastro-enterostomy and appendectomy were

performed. Postoperatively he received a total of 500 c.c. of whole blood and two 500 c.c. transfusions of pooled plasma. The latter transfusions were done on May 18 and 19 respectively. At the time of this admission physical examination was essentially negative with the exception of a rather high value for blood urea which was reduced readily by intravenous administration of fluids. The patient was dismissed from the hospital June 6. He was feeling well, was able to eat and had gained weight.

The patient was again admitted to the Clinic July 24, 1946, for emergency treatment. At that time it was stated that three days previously he had experienced a chill, had become nauseated and had vomited; he had begun to hyperventilate shortly after that and had continued to do so until admission. At the onset of his illness he had not been conscious of jaundice until this was drawn to his attention by the family physician. On admission to the Clinic he was found to be mildly icteric, was breathing rapidly and deeply and insisted that this rapid breathing had been present ever since the onset of his illness three days previously. The liver

was enlarged 2 cm. below the costal margin (on the basis of 1 to 4 in which 1 represents the least severe and 4 the most severe condition). The flocculation test for syphilis gave a negative reaction. There was elevation of the left hemidiaphragm. The value for blood urea was 34 mg. per 100 c.c. and the chloride content of the blood was 538 mg. per 100 c.c. The value for the carbon dioxide combining power was 21.1 volumes per 100 c.c. of plasma; this was rapidly corrected to 57.9. The content of serum bilirubin was 19.8 mg. per 100 c.c. direct and 4.2 indirect. Ten hours after admission the patient became slightly disoriented and within thirty minutes had lapsed into rather deep coma from which he could not be aroused. The lower extremities were rigid and the Babinski and Hoffman reflexes were positive bilaterally. The prothrombin time by the Quick method was 90 seconds. The patient's temperature rose rapidly to 102° F. and the last day

was 104° F. His pulse became 140 per minute, his value for serum and on July 26

there were petechiae in the right axilla. The right lobe and that

cubic millimeter of blood. Blood smears showed some hyperchromasia with evidence of moderate toxic changes in the polymorphonuclear leukocytes. The flocculation test for syphilis gave a negative reaction. Serum protein on admission measured 4.8 gm per 100 cc of serum and the albumin-globulin ratio was 1.65:1. Roentgenologic examination of the thorax gave negative results.

Because of the low value for serum protein and the patient's poor general condition he was given a transfusion of 250 cc of pooled plasma on June 29, 1946. Many methods of treatment were employed in an effort to improve his skin condition, among which were intramuscular administration of boiled whole milk, roentgen therapy, beta-dimethylaminoethyl benzhydryl ether hydrochloride (benadryl), pentamethylene tetrazol (metrazol) and tripeleennamine (pyribenzamine). About five days before death a fever without leukocytosis, some nausea and vomiting developed. Vomited material began to contain shreds of coffee-colored



Fig 302 (Case 2) —Liver. Note similarity to gross appearance of chronic passive congestion.

material and some blood clots and the day before death the patient complained of tenderness in the right upper quadrant of the abdomen. The liver was palpable. The serum bilirubin at that time measured 2.5 mg per 100 cc and gave a direct van den Bergh reaction. Within twenty-four hours the patient became desperately ill, his pulse became irregular and he died.

At necropsy a generalized, scaling erythematous eruption of the cutaneous surfaces was noted. The heart revealed a moderate degree of coronary sclerosis with several small regions of fibrosis in the interventricular septum. The ventricles were

The liver weighed 1,185 gm. It was dark red in color and the capsule was wrinkled. Consistency was greatly decreased, the organ appearing very flabby. The cut surface revealed a mottled yellow and red appearance. The markings were more distinct than usual and in this regard the appearance resembled that of severe chronic passive congestion.

The mucous membrane of the esophagus appeared normal but the wall was slightly thickened. Immediately distal to the pylorus there was a round depression in the mucosa of the duodenum which measured 1.5 by 1.0 cm. It was covered by epithelium. The suture lines of the previous gastro-enterostomy appeared to be well healed. The small intestine and the colon each contained approximately 1,000 cc. of old blood. In the transverse colon there were a number of

the kidneys did

which measured 4 by 2.5 by 2 cm. The brain was not otherwise abnormal in appearance.

Histologic Examination—In sections of the heart evidence of hemorrhages was observed in the endocardium of the left ventricle and in the leaflets of the aortic valve. Sections of the lower lobe of the left lung revealed polymorphonuclear

In the hepatic cells had been completely destroyed. Cells persisted in the periportal region. There was evidence of degeneration such as atrophy, fatty change and the accumulation of large amounts of brownish pigment. The central portions of the hepatic lobules were occupied by collapsed reticulum fibers, large numbers of erythrocytes and phagocytes which contained brownish pigment, small numbers of lymphocytes and plasma cells and a few polymorphonuclear cells. There was no evidence of regeneration in the parenchymal cells.

In the portal areas there were large numbers of inflammatory cells in the portal tracts.

tubular connective tissue. A few of the tubules contained bile-stained casts. The epithelium of the convoluted tubules was swollen and finely vacuolated.

This undoubtedly represents a fulminant case of homologous serum jaundice after administration of whole blood three days after the transfusion. It is assumed that the icterogenic agent may have been transmitted by the two transfusions of whole blood. The donors, however, never had had jaundice. This represents a very fulminating type of the disease and in spite of treatment with blood, oxygen, continuous intravenous administration of glucose and vitamin supplements the patient died after a short illness.

Histologic Examination—For the sake of brevity the appearance of the liver only will be described

In the central portions of the hepatic lobule practically all the hepatic cells had been destroyed and removed (fig 303 a) In the spaces previously occupied by those cells there were numerous erythrocytes and phagocytes containing brownish yellow pigment A few lymphocytes and monocytes were present but polymorphonuclear leukocytes were rarely observed The only hepatic cells that remained were found in narrow zones at the periphery of the lobule and even these revealed profound degenerative changes such as atrophy hyaline granular degeneration of the cytoplasm and fatty degeneration (fig 303 b) Pyknotic nuclei and karyorrhexis were not infrequently observed Evidences of regeneration were minimal and sparse at the periphery of the lobule They consisted of small cells with hypertrophied nuclei The reticular framework

Case 2 brings up the problem of differentiating between toxic and infectious hepatitis In the

clinical or the histopathologic data In favor of the thesis that hepatotoxins were responsible for the destruction of the liver in this case was the presence of hepatic cells in varying stages of degeneration Cells were observed which showed evidence of fatty degeneration eosinophilic granular degeneration and complete necrosis According to Lucké the agent in homologous serum hepatitis responsible for the necrosis of hepatic cells effects speedy lysis and enzymic digestion rather than cell coagulation as seen in the necrosis of anoxemia and after the action of many hepatic poisons Wood and Black however have described varying degenerative changes in the hepatic cells in their acute cases of homologous serum hepatitis in which death occurred within a few days

In case 2 severe nausea and vomiting developed exactly ninety days after pooled plasma had been administered The patient was dead within five days from the onset of symptoms with a rise in value for serum bilirubin only to 2.5 mg per 100 cc This probably represents a very fulminating type of serum hepatitis Some question may be raised as to whether or not administration of benadryl or pyribenzamine affected this patient's course Pyribenzamine was given in doses of only 50 mg four times a day for a total of twenty seven days and benadryl was administered for twenty days in doses of 100 mg four times a day These drugs together with metrazol were given in the hope of relieving the pruritus which was extremely severe The microscopic specimen from the liver showed a hepatic lesion which was not exactly typical of that usually seen in fatal serum hepatitis However the onset of the patient's rapidly fatal course ninety days after administration of possibly icterogenic plasma is most suggestive that this was a case of serum hepatitis

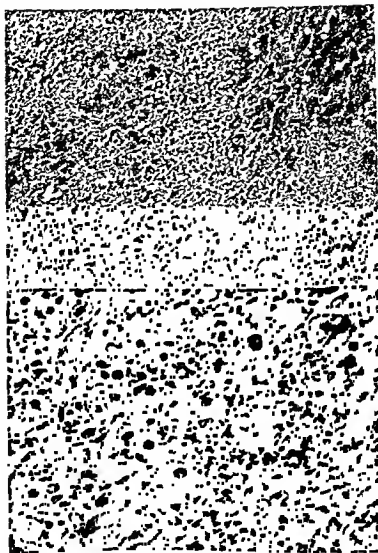


Fig. 303 (Case 2) —Liver *a*, In the central portion of the lobules practically all hepatic cells have been destroyed and removed (hematoxylin and eosin \times 110) *b*, Hepatic cells at periphery of a lobule. Note atrophy fatty and hyaline granular degeneration (hematoxylin and eosin \times 435)

pear abnormal. The left kidney weighed only 40 gm. but apart from its small size did not appear remarkable.

Examination of the brain revealed a moderate amount of atrophy but nothing else of note.

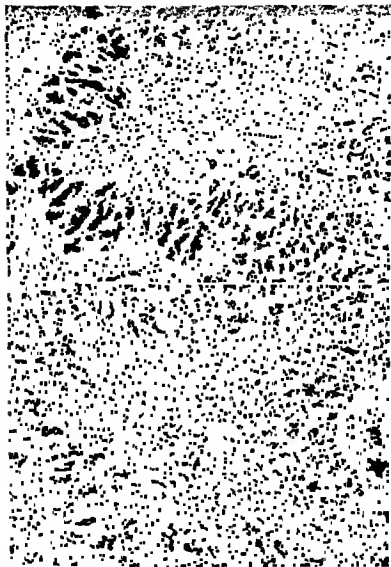


Fig 304 (Case 3) —Liver *a*, Cells in the center of the lobule have been destroyed and removed. A narrow zone of viable cells remains at the periphery of the lobule (hematoxylin and eosin $\times 95$). *b*, The reticular framework of the lobule remains intact (Gomori reticulum stain $\times 100$)

In the recent exhaustive studies of the fulminant form of epidemic and serum hepatitis of Lucké and Mallory it was pointed out that the hepatic lesions found in the "spontaneous" and in the "inocula-

CASE 3—A woman twenty-eight years old registered at the Clinic December 18, 1940. Her family and personal history was essentially negative. There was no previous history of hepatitis or of any hepatitis in her community. She had accompanied her husband to the Clinic and on December 15 began to complain of rather severe malaise, loss of appetite, and a feeling of fullness in the upper abdomen and some

slight jaundice and rather marked tenderness and spasm in the right upper abdominal quadrant, the spleen was palpable and deep breathing aggravated her pain. She was admitted to the hospital December 21 and physical examination showed her to weigh 105 pounds (47.6 kg.), the scleras and skin were icteric; the icterus had first been noticed three days previously. She was dehydrated and was quite clear mentally. The liver was palpable 1 to 2 cm. below the costal margin and was soft, there was considerable tenderness. The spleen was palpable about 1 cm. below the left costal border. The remainder of the examination gave essentially negative results. The following morning the patient was drowsy but was able to give a history of her illness.

some hypochromasia. A routine flocculation test for syphilis gave a negative reaction. The content of serum bilirubin was 10.1 mg. per 100 cc. direct and 4.7 indirect, serum protein measured 5.8 gm. per 100 cc. and the value for serum amylase was 80 units (Somogyi). The concentration of blood urea was 10 mg. per 100 cc. and the prothrombin time was 25 seconds on admission, this rapidly rose to 79 seconds. The cephalin cholesterol flocculation test gave a 4 plus reaction. Roentgenologic examination of the thorax and spot films of the gallbladder region revealed no evidence of disease. Spinal fluid examination gave negative results.

Within the next twenty-four hours the patient's condition rapidly declined, she went into deep coma and her temperature rose to 105.6° F., in spite of heroic efforts at treatment she died. At the time of her death the value for serum bilirubin was 10.6 mg. per 100 cc. direct.

In this case we were unable to obtain permission for a complete necropsy. Consent was obtained to secure only a small specimen of liver for histologic and chemical examination.

Histologic Examination—The liver was completely destroyed (the capsule had not yet collapsed). Lymphatic spaces and the central veins in the spleen contained numerous erythrocytes, small numbers of lymphocytes and mononuclear leukocytes, and phagocytes which contained vacuoles and brownish pigment. Only an occasional polymorphonuclear leukocyte was observed. The remaining cords of cells at the periphery of the lobule were widely separated and revealed evidence of atrophy, fatty change and accumulations of brownish pigment in the cytoplasm. There was no evidence of cellular regeneration. The bile canaliculi were

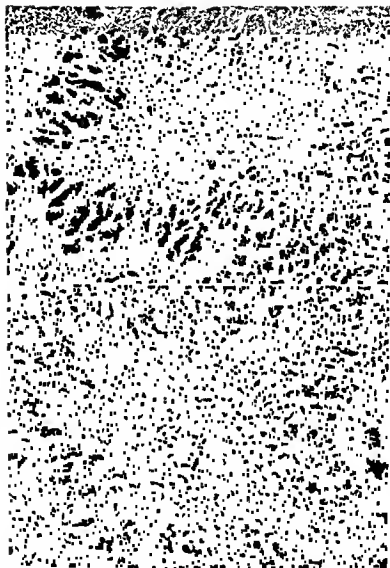


Fig 304 (Case 3) —Liver *a*, Cells in the center of the lobule have been destroyed and removed. A narrow zone of viable cells remains at the periphery of the lobule (hematoxylin and eosin $\times 95$) *b*, The reticular framework of the lobule remains intact (Gomori reticulum stain $\times 100$).

In the recent exhaustive studies of the fulminant form of epidemic and serum hepatitis of Lucké and Mallory it was pointed out that the hepatic lesions found in the "spontaneous" and in the "inocula-

CASE 3—A woman twenty eight years old registered at the Clinic December 18 1946. Her family and personal history was essentially negative. There was no previous history of hepatitis or of any hepatitis in her community. She had accompanied her husband to the Clinic and on December 15 began to complain of rather severe pain localized in the right upper quadrant of the abdomen and associated with nausea and vomiting. There were no chills or fever. The distress lasted most of the night but the next morning had nearly disappeared. Vomiting continued however. Three days later there was a temperature of 99.6° F., she had slight jaundice and rather marked tenderness and spasm in the right upper abdominal quadrant. The spleen was palpable and deep breathing aggravated her pain. She was admitted to the hospital December 21 and physical examination showed her to weigh 105 pounds (47.6 kg.), the scleras and skin were icteric—the icterus had first been noticed three days previously. She was dehydrated and was quite clear mentally. The liver was palpable 1 to 2 cm. below the costal margin and was soft; there was considerable tenderness. The spleen was palpable about 1 cm. below the left costal border. The remainder of the examination gave essentially negative results. The following morning the patient was drowsy but was able to answer requests to some degree. The pupils were rather large but reacted normally. Examination of the reflexes showed them all to be normal.

Laboratory examinations at this time showed normal urine and normal blood and differential counts but blood smears showed mild general macrocytosis with some hypochromasia. A routine flocculation test for syphilis gave a negative reaction. The content of serum bilirubin was 10.1 mg. per 100 cc. direct and 4.7 indirect. Serum protein measured 5.8 gm. per 100 cc. and the value for serum amylase was 80 units (Somogyi). The concentration of blood urea was 10 mg. per 100 cc. and the concentration of blood glucose was 100 mg. per 100 cc. The rapidly

results

Within the next twenty four hours the patient's condition rapidly declined, 105.6° F. in spite of heroic treatment. The value for serum bilirubin

Consent was obtained to secure only a small specimen of liver for histologic and chemical examination.

Occupied by hepatic cells there were lymphocytes and mononuclear leukocytes and phagocytes which contained vacuoles and brownish pigment. Only an

of small bile ducts

Chemical analysis of the liver for arsenic revealed only 0.08 mg. per 100 gm. of tissue. It was concluded that this concentration of arsenic was not sufficient to account for the extensive hepatic damage observed.

indirect Thymol turbidity was 6 units the cephalin cholesterol flocculation test gave a 3 plus reaction and the prothrombin time was 20 seconds Maternal obtained by duodenal drainage showed a faint trace of bile Over a period of four weeks the content of serum bilirubin decreased from 10.6 to 1.8 mg per 100 cc

The patient's icterus appeared about ninety days after he had received 500 cc of pooled plasma Serum hepatitis is the most likely diagnosis It is conceivable, however, that this might have been a recurrence of the early acute infectious hepatitis which he had had at the age of sixteen, although this latter seemed most improbable

CASE 5—A woman thirty two years old was seen at the Clinic in 1940 A diagnosis of thrombocytopenic purpura was made and because of this condition the spleen was fused until upper quadrant lasting one or two minutes About the same time she noticed some nausea and anorexia clinical jaundice clay colored stools and dark urine

Physical examination showed her to be very deeply jaundiced The liver was not palpable but a definite fetor hepaticus was noted The remainder of the physical examination was essentially negative Laboratory investigations revealed normal urine, 14.7 gm of hemoglobin per 100 cc of blood and 4,800,000 erythrocytes and 6,600 leukocytes per cubic millimeter of blood Blood smears disclosed —

coagulation test gave a 4 plus reaction and thymol turbidity was 8 units By duodenal drainage 20 cc of amber colored bile was obtained The patient made a satisfactory recovery

This appears to be a true case of serum hepatitis in which the incubation period was about 108 days

CASE 6—A man forty years old was first admitted to the Clinic in 1937 at which time he was found to have a duodenal ulcer partial gastrectomy of the posterior Polya type was done for subacute perforated duodenal ulcer His next admission

ally stools were normal
cet
int

of pooled plasma On December
whole blood and started on

nausea without vomiting and easy fatigability dark urine had been noted for the first time March 4 the patient had first noticed icterus This was 74 days after he had had plasma and 62 days after the transfusion of whole blood Since the appearance of jaundice the patient had had rather marked anorexia and had lost about 10 pounds (4.5 kg)

Physical examination
liver was
margin, the

tion" type of hepatitis were similar in every respect. Cases 1 and 2, which represent examples of homologous serum hepatitis and the sporadic type of acute infectious hepatitis respectively, lend further support to this impression.

In these fulminant forms of acute hepatitis, lesions other than those found in the liver are usually insignificant. Grossly the liver gives little indication of the amount and extent of the hepatic damage. It usually is of decreased consistency, moderately atrophied and the capsule is finely wrinkled. The cut surface usually has the appearance of rather severe chronic passive congestion, the so-called nutmeg pattern.

Histologically the reason for this similarity to the appearance of chronic passive congestion is found to be the extensive necrosis and disappearance of hepatic cells from the central portions of the lobule.

Lucke and Mallory the inflammatory infiltration was most conspicuous at the periphery of the lobule but in cases 1 and 2 it was most prominent in the central portions of the damaged lobule. In agreement with their description was the practically complete absence of regenerative hyperplasia. The only intact parenchymal cells were found at the periphery of the lobule. These cells revealed such changes as atrophy, fatty change and the accumulation of pigment. The bile canaliculi associated with these cells were usually occluded by bile thrombi. Slight proliferation of the small bile ducts was apparent in case 3. The destructive process in this acute form of the disease apparently involves all parts of the liver uniformly.

CASE 4—A male farmer thirty-four years old was first seen at the Clinic November 6, 1946, when he was brought in for emergency treatment because of icterus. Shortly after admission he received a transfusion of whole blood. From the hospital a month later he felt well and returned to his home.

He had no previous history of illness and no known exposure to any of the usual causes of hepatitis.

On admission the patient was found to be icteric and had a mild fever. The liver was enlarged and the spleen was palpable.

Stools became acholic and the urine dark and pruritus became increasingly intense.

On examination he was found to be icteric and had the excoriations of the skin so commonly seen in pruritus. The liver was just palpable and the spleen could not be felt. Fotor hepaticus was rather marked. Laboratory examinations showed normal urine, 15.2 gm. of hemoglobin per 100 cc. of blood and 8,000 leukocytes per cubic millimeter of blood. The serum bilirubin measured 10.6 direct and 1.9 indirect.

respectively, 177 and 59 mg per 100 cc of plasma on admission the value for serum bilirubin was 8.5 mg per 100 cc direct and 1.6 indirect. The concentration of serum protein was 6.6 gm per 100 cc with an albumin globulin ratio of 1:1. Additional laboratory findings are indicated in table 1.

The patient continued to improve while in the hospital his anorexia disappeared and he gained weight.

This undoubtedly was a case of serum hepatitis following transfusion of whole blood. The icterus developed about eighty five days after administration of blood and the patient showed the usual, rather difficult course of this disease in the aged person. The difficulty in diagnosis here lies in the fact that the man was in the cancer age group and that serum hepatitis is very uncommon after blood transfusion.

CASE 8—A woman fifty two years old had always been in fairly good health. She gave no previous history of jaundice. On April 26, 1946 she had undergone hysterectomy because of marked menorrhagia and at that time received two transfusions of whole blood one of these transfusions was from a young army sergeant who had had hepatitis two years previously while stationed in the south western part of the United States. The patient made a satisfactory recovery from her operation. On September 1 she first noted onset of painless jaundice and passage of dark urine accompanied by nausea considerable malaise and headache. She did not go to bed but was up and about. Gradual improvement was noted but on September 20 she had a recurrence of marked nausea jaundice became more intense the urine was dark and the patient felt extremely uncomfortable. There was some discomfort in the right upper abdominal quadrant.

On admission to the Clinic September 27 1946 laboratory examinations revealed normal urine 14.8 gm of hemoglobin per 100 c.c. of blood and 5,070,000 erythrocytes and 5,600 leukocytes per cubic millimeter of blood. A routine flocculation test was negative. The serum protein was 6.8 gm per 100 cc as 3.17 gm per 100 cc in protein ratio of 1.05 to 1.00.

bed was advised

This patient was extremely ill and presented a hepatitis which occurred 127 days after two transfusions of whole blood. It seems that serum hepatitis would be the most likely diagnosis. Here again one is confronted with the possibility that the jaundice was produced by a malignant lesion.

CASE 9—A man thirty-one years old had had a history of left renal stone since 1943 and in June 1946 he had undergone nephrectomy on the left. The wound continued to drain and on July 15 he was given a transfusion of whole blood because of anemia. The draining sinus had continued.

pruntus. The remainder of the physical examination gave essentially negative results. Laboratory investigations revealed normal urine 11.5 gm. of hemoglobin per 100 c.c. of blood and 4 090 000 erythrocytes and 5 600 leukocytes per cub c millimeter of blood. The differential count was normal and routine flocculation tests for syphilis gave negative results. Roentgenograms of the thorax and spot films of the gallbladder region revealed no evidence of disease. The serum bilirubin concentration on March 15 was 11 mg per 100 c.c. direct and 19 indirect. The cephalin-cholesterol flocculation test gave a 4 plus reaction on March 19. The prothrombin clotting time on admission was 21 seconds and five days later it was 18 seconds.

Over a period of three weeks the serum bilirubin content decreased from 11 to 2.4 mg per 100 c.c. and the thymol turbidity remained between 6 and 8 units. This patient also was able to eat approximately 4 000 calories a day and showed gradual improvement.

Here again is a man past forty years of age with painless jaundice in whom one must suspect the possibility of malignancy. However in this case the diagnosis seems rather obvious in view of the previous history of the administration of blood plasma and the spontaneous clinical recovery.

TABLE 1
LABORATORY DATA ON A PATIENT WITH SERUM HEPATITIS (CASE 7)

	March								April	
	5	8	12	15	1	4	6	28	4	7
Serum bilirubin, mg	8.5	6.6	4.7	4.2	4.4	3.5	4.0	2.9	2.6	
Cholesterol esters, mg	59			69	75	72	94			100
Thymol turbidity units	15		15			8		10	10	
Cephalin-cholesterol flocculation reaction	4+		4+						4+	
Prothrombin time, seconds	22	21		0	20	18				
Stool urobilinogen, Ehrlich units per 24 hours	60.9		58.9							

CASE 7.—A man sixty-one years old had undergone gastro-enterostomy in 1923 at the Clinic for an intractable duodenal ulcer. In 1924 cholecystectomy had been performed because of vague indigestion but no stones were found. On

negative results. The hematocrit was 45 per cent, the hemoglobin was 11.6 gm per 100 cc of blood, the erythrocytes 5,250,000 per cubic millimeter of blood, the leukocytes 10,000 per 100 cc, for cholesterol 155, and for cholesterol esters 40. Serum bilirubin giving the direct reaction measured 17.4 mg per 100 cc and that giving an indirect reaction 2.7. The concentration of serum protein was 7.6 gm per 100 cc with an albumin globulin ratio of 1:1.9. Thymol turbidity was 5 units, the sedimentation rate was 58 mm in one hour (Westergren), and the content of serum amylase was less than 50 units. The prothrombin clotting time was 27 seconds. Roentgenologic examination of the gallbladder region disclosed two rounded areas of increased density at the right

scapular region. There was tenderness over the epigastrium and over the right upper quadrant of the abdomen, but no rigidity was present. On examination one got the impression of fullness in the right upper part of the abdomen. A hypodermic injection of morphine was required for relief of pain. The following morning some tenderness in the right upper abdominal quadrant remained but because of the high content of bilirubin in the serum and the marked evidence of hepatic damage it was decided to postpone surgical intervention as long as possible. Four days later another similar attack occurred. On March 19, two days prior to operation, the value for serum bilirubin dropped to 9 mg per 100 cc and that for cholesterol esters increased to 79 mg per 100 cc.

For several weeks Examination of the remainder of the abdominal structures revealed normal conditions except that just beyond the pyloric ring on the anterior superior wall of the duodenum there was a large, acute ulcer with a crater 1 cm in diameter. Tissue from the liver removed for biopsy was reported as showing obliterative cholangitis. Convalescence from the operation was satisfactory.

In this case diagnosis was a difficult problem. The icterus appeared 160 days after administration of plasma and serum hepatitis seemed a likely diagnosis. It still does seem the probable diagnosis in view of the report on biopsy of the liver even though a diseased gallbladder containing stones was encountered. It is realized that an incubation period of 160 days is rather a stretch of the upper limit of normal but it seems within the range of possibility.

CASE 12—A woman aged thirty-nine years was admitted to the Clinic February 4, 1947. The family history was negative. She always had enjoyed good health until the fall of 1945 when she had had six rather severe attacks of epigastric pain with radiation around both costal margins to the back and with a duration of ten to thirty minutes. These required no opiates for relief. She was treated for hyperthyroidism because of a basal metabolic rate of +35. She recovered from these spells and had no further trouble until September, 1946, when she began to complain of low back pain which was worse at night. On

On admission to the Clinic August 19, 1946, the patient presented a urologic problem details of which are not essential to this history. On October 5 he began to notice dark urine and light stools, began to have pain in the right upper abdominal quadrant and five days later first noted jaundice. At that time the hemoglobin content was 14 gm per 100 cc, the erythrocytes numbered 4,740,000 and the leukocytes 9,000 per cubic millimeter of blood. Pyuria was graded 3. Roentgenologic examination of the thorax and a flocculation test for syphilis gave negative results. The value for direct reacting bilirubin in the serum was 8.4 mg

edge of the liver was palpable and very tender. Jaundice cleared rather rapidly but the patient complained of considerable nausea. He remained in the hospital until November 16 for treatment of the urinary infection.

This young man exhibited painless jaundice eighty seven days after receiving a transfusion of whole blood. The condition was of rather mild nature but undoubtedly represented an instance of serum hepatitis.

CASE 10—A woman twenty nine years old on March 8, 1946, after a normal pregnancy, had prolapse of the cord, rupture of the uterus and emergency hysterectomy. At that time 3,000 cc of whole blood was administered together with

serum bilirubin content was 16 mg per 100 cc direct. The liver was enlarged, extended about 4 cm below the costal border and was slightly tender. The cephalin-cholesterol flocculation test gave a 4 plus reaction and the prothrombin time was 23 seconds. On May 9 the serum bilirubin content was 2.7 mg per 100 cc direct. On September 12 the patient had no direct reacting bilirubin in the serum. Recovery was satisfactory.

In this case of hepatitis the onset occurred thirty five days after administration of a very large quantity of blood and 500 cc of pooled plasma. It would be difficult to say whether or not this was a case of real serum hepatitis or one of sporadic infectious hepatitis. Certainly the incubation period seems rather short for serum hepatitis.

CASE 11—A woman forty four years old had always been in good health. September 8, 1946 she had had a malignant tumor the exact nature of which is

urine with

On initial examination the patient was found to be brightly icteric, the liver was enlarged and tender and the tip of the spleen was palpable. The remainder of the physical examination was negative. The urine was negative for urobilinogen, the erythrocytes were 10 per cent of the total, the sedimentation rate was 10 mm. per hour. The ologistic test for syphilis gave a negative reaction. The value for serum protein was 7.4 gm. per 100 cc. with an albumin globulin ratio of 1.4:1. The content of urobilinogen in a twenty-four hour stool specimen was 42 Ehrlich units. Roentgenologic examination of the thorax, stomach and duodenum gave negative results. Other pertinent laboratory data are shown in table 2.

This patient had no history of having taken anything parenterally but we later discovered that there had been an epidemic of some twenty-five cases of infectious hepatitis in the place in which he lived so that this no doubt represented a case of infectious hepatitis in the older age group. The rather long period of malaise, the discomfort in the right upper quadrant, the results of constant observation, the rapid fall in the concentration of serum bilirubin and the improvement in cholesterol ester concentration all pointed to an intrahepatic type of jaundice.

SUMMARY

It is well to remember that any hepatitis which occurs from sixty to 150 days after the administration of blood or plasma or after other parenteral therapy should be considered as serum hepatitis until proved otherwise. There apparently is no decrease in susceptibility to the disease with advancing age and it must be treated as a disease which causes appreciable mortality.

The onset and course of serum or infectious hepatitis may at times closely simulate those of stricture of the common duct, ampullary cancer or a malignant lesion of the head of the pancreas and may offer difficult problems in diagnosis.

These findings are based on the study of 100 cases of hepatitis, 50 of which were of the serum type and 50 of the infectious type. The results of the study are summarized in the following table.

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when she began to have pruritus of the arms and back, she felt weak, complained of anorexia and later suffered from nausea and vomiting January 18 1947 icterus was noted for the first time, this progressed for two or three weeks and then decreased

On admission to the hospital February 4, 1947, the patient's scleras were icteric, the liver was just palpable and the spleen was not felt. The systolic blood pressure was 136 mm of mercury and the diastolic 82. Laboratory tests revealed normal urine 15.4 gm of hemoglobin per 100 c.c. of blood and 4,500,000 erythrocytes and 5,200 leukocytes per cubic millimeter of blood. The serum bilirubin measured 4.8 mg per 100 c.c. direct and 0.7 indirect, serum proteins measured 7.2 gm per 100 c.c. and the albumin globulin ratio was 1.65:1. The value for blood urea was 18 mg per 100 c.c. of blood for chlorides 633 mg per 100 c.c. of plasma, for cholesterol 155 and for cholesterol esters 67. The cephalin-cholesterol flocculation test gave a 4 plus reaction, thymol turbidity was 10 units with thymol flocculation reaction 5 plus. There were 42 mg of urobilinogen in the stool and 12 mg in the urine in twenty-four hour specimens. The prothrombin time was 20 seconds and the basal metabolic rate was +2. Roentgenologic examination of the thorax revealed normal findings. A routine flocculation test for syphilis gave negative results.

During the patient's stay in the hospital her pruritus disappeared she began to eat well and felt much better. Within two weeks the content of serum bilirubin had dropped to 1 mg per 100 c.c. direct and 0.1 mg indirect.

With this type of history one would suspect that the most likely diagnosis would be stricture of the common duct with some early chronic hepatitis and jaundice but in view of the fact that the patient had received 500 c.c. of pooled plasma three months previously one had to consider the possibility of homologous serum hepatitis. Of course it is possible that she may also have had a stricture but surgical intervention at this time was deferred.

CASE 13—A sawmill owner forty-five years old always had been in good health but around Christmas in 1946 he began to notice anorexia. About two weeks later

on March 19

TABLE 2
LABORATORY DATA ON A PATIENT WITH EPIDEMIC INFECTIOUS HEPATITIS
(CASE 13)

Date	Serum Bilirubin mg per 100 c.c.	Cholesterol mg per 100 c.c.	Cholesterol Esters mg per 100 c.c.	Thymol Turbidity units	Cephalin- Cholesterol Flocculation Reaction
March 19	16	~10	54	18	4+
March 24	14	18	49	12	
March 25	" "	210	" "		
April 2	4.6			10	4+
April 7	2.6	260	242	6	

ACUTE OBSTRUCTIVE CHOLECYSTITIS WITHOUT CHOLELITHIASIS

PAUL KIERNAN

THE subject, acute cholecystitis, has recently received a great deal of attention. The term "acute obstructive cholecystitis" is probably more descriptive of the condition and the obstructive component in the great majority of cases is found to be a stone. This is usually impacted in the entrance of the cystic duct and if not passed leads to distention of the gallbladder, chemical cholecystitis because of the contained bile, ischemia, gangrene, necrosis and perforation of the wall of the gallbladder. This may lead to a localized abscess or, if it is a free perforation, to bile peritonitis and death. The obstruction of course, may be relieved by formation of a fistula or by formation of a tract, through which the stone may be extruded.

All of the cases in which acute obstructive cholecystitis was encountered at the Mayo Clinic from January 1, 1942, to December 31, 1946 inclusive, were reviewed. One hundred and two cases were found. In eighty-seven of these cases the condition was treated surgically and in fifteen, for various reasons, operation was not performed. In the latter group three patients died and the gallbladder was studied. Therefore, of the original group (102) the pathologic process was known in ninety cases. In this group stones were found to be present in the gallbladder or cystic duct in 95.5 per cent of the ninety cases. Interest was therefore centered on the four cases of "acute obstructive cholecystitis" without stones in the gallbladder or cystic duct.

Because of the known pathogenesis of the condition when the gallbladder is obstructed by stones, it was thought worth while to study these cases without obstruction by cholecystic calculus in an effort to explain the nature of the obstructive element. The cases will therefore be discussed in detail.

REPORT OF CASES

CASE 1—The patient, a white woman, aged sixty six years, registered at the Clinic and was admitted directly to the hospital on October 5, 1943, with the complaint of abdominal pain of five weeks' duration.

Eleven years before, in 1932, she first had noted periodic attacks of pain in the right upper abdomen.

* The entire series will be presented in a subsequent paper.

- on the
dice)
- 4 Hoaglan cases
- 5 Lucké, *fulminant form of epidemic hepatitis* (May) 1944
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All of the cases in which acute obstructive cholecystitis was encountered at the Mayo Clinic from January 1, 1942 to December 31, 1946 inclusive, were reviewed. One hundred and two cases were found.* In eighty seven of these cases the condition was treated surgically and in fifteen, for various reasons, operation was not performed. In the latter group three patients died and the gallbladder was studied. Therefore, of the original group (102) the pathologic process was known in ninety cases. In this group stones were found to be present in the gallbladder or cystic duct in 95.5 per cent of the ninety cases. Interest was therefore centered on the four cases of "acute obstructive cholecystitis" without stones in the gallbladder or cystic duct.

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REPORT OF CASES

CASE 1—The patient, a white woman aged sixty six years, registered at the Clinic and was admitted directly to the hospital on October 5, 1943, with the complaint of abdominal pain of five weeks duration.

Eleven years before, in 1932, she first had noted periodic attacks of pain in the right upper quadrant of the abdomen, followed by "soreness." She stated that four years later cholecystostomy had been performed and at that time she had been found to have diabetes mellitus. Two weeks after operation she again complained of colicky abdominal pain accompanied by chills and fever. These attacks quickly subsided and she was well until five weeks before admission to the Clinic.

* The entire series will be presented in a subsequent paper.

- [illegible]

tro-enterostomy was carried out and a lymph node was removed for biopsy. This proved to be adenocarcinoma, grade 2 (Broder's method). The postoperative convalescence was uneventful and the patient was dismissed from the Clinic on the twentieth postoperative day. Word was received of her death November 17, 1944.

CASE 2—The patient, a white man, aged sixty-eight years, registered at the Clinic and was admitted for emergency treatment directly to the hospital on June 1, 1945, with the complaint of abdominal pain of three days' duration. The past history was negative except for some qualitative indigestion of three months duration. The present attack of pain in the right upper quadrant of the abdomen was sudden in onset, colicky and was referred into the back and right shoulder. Thus colicky pain persisted except when relieved by morphine.

Physical examination gave negative results except for abdominal tenderness and marked muscle spasm in the right upper quadrant. Urinalysis gave negative results. The concentration of hemoglobin was 15.4 gm per 100 cc of blood. Leukocytes numbered 10,900 per cubic millimeter of blood. The sedimentation rate (Westergren) was 33 mm per hour. Serum amylase was less than 50 units.

A diagnosis of acute obstructive cholecystitis was made and exploration was performed with negative results except for the gallbladder, which was found to be markedly edematous and acutely inflamed. It was removed. The pathologic report was "acute gangrenous cholecystitis with percholecystitis." No stones were found in the gallbladder or ducts. The convalescence was uneventful and the patient was dismissed on the thirteenth postoperative day.

CASE 3—A white man, aged fifty-one years, registered at the Clinic July 23, 1946 and was admitted directly to the hospital for emergency treatment with the complaint of abdominal pain of seven hours duration. In the past two years the patient had experienced three attacks of colicky pain in the right upper quadrant of the abdomen which had subsided spontaneously without his consulting a physician. The day he was admitted he was seized with sudden severe pain in the right upper quadrant with extension into the left upper quadrant of the abdomen. This pain persisted and was unreheved by vomiting, which followed the ingestion of soda.

Physical examination revealed a very obese man in acute distress. The positive findings were limited to the abdomen. The temperature was 100.2° F, pulse 110, respirations 18, and blood pressure 110/60 mm Hg.

A diagnosis of acute pancreatitis and diabetes mellitus was made. A conservative plan of treatment was followed. Daily estimations of the serum amylase and leukocyte count were made and found to be as follows:

	Serum amylase	Leukocyte count
July 24, 1946	2,000 units	7,200
July 25, 1946	400 units	7,000
July 26, 1946	100 units	6,700

General improvement was also noted until on July 25, two days after admission, the patient experienced a chill and a temperature of 103° F and exacerbation of the abdominal pain. At this time he also complained of severe pain in

when chills, fever and attacks of colicky pain in the right upper quadrant extending into the back recurred. Three weeks later, for the first time, jaundice was noted. This had been progressive and had been accompanied by pruritus, light stools and dark urine. During this time there had been a loss of 18 pounds (8.2 kg.).

Physical examination revealed an obese, icteric woman in acute distress. The positive findings were otherwise limited to the abdomen. A well-healed old upper right rectus incision was noted. There was marked tenderness over the entire abdomen but particularly in the right upper quadrant, although thought to be a distended gallbladder (on the basis of 1 to 4, in-
tration of sugar). Leukoc-
the concentration of hemog-
was 216 mg. per 100 cc
direct, the sedimentation rate (Westergren) was 116 mm per hour, the pro-
thrombin time was 23 seconds, the average normal being 18 seconds (Quick). A
roentgenogram of the thorax and a simple roentgenogram of the abdomen were
reported as normal.

The diagnosis was obstructive jaundice, stone in the common duct or carcinoma of the head of the pancreas. After preparation, which consisted of control of the diabetes and administration of vitamin K, a cholecystectomy was performed through a secondary incision. The gall bladder was found to be acutely inflamed and distended, particularly into the abdominal wall. The gall bladder had also completely penetrated the abdominal wall, and a specimen 10 cm in diameter and several specimens of the gall bladder were obtained.

duct had entered through the common duct into the duodenum and upper part of the jejunum and brought out through the incision.

The patient's convalescence was uneventful and the jaundice completely subsided. A cholelithogram indicated some dilatation of the common duct. The

tion of the lower part of the
was then dismissed to return in
1944, she reregistered at the
and the physical examination
the urine to be normal. The
00 cc of blood Erythrocytes
mic millimeter of blood The
r hour Serum bilirubin was

normal.

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Physical examination revealed a very obese man in acute distress. The positive findings were limited to the abdomen. There was tenderness over the entire right

right side

upper qua

tration of

11,000 per cubic millimeter of blood. The sedimentation rate (Westergren) was 18 mm per hour, the concentration of urea was 32 mg per 100 cc of blood, that of sugar was 256 mg per 100 cc of blood, serum amylase was 4,000 units. A diagnosis of acute pancreatitis and diabetes mellitus was made. A conservative plan of treatment was followed. Daily estimations of the serum amylase and leukocyte count were made and found to be as follows:

	Serum amylase	Leukocyte count
July 24, 1946	2,000 units	7,200
July 25, 1946	400 units	7,000
July 26, 1946	100 units	6,700

General improvement was also noted until on July 25, two days after admission, the patient experienced a chill and a temperature of 103° F and exacerbation of the abdominal pain. At this time he also complained of severe pain in

the back and a definite mass was palpable in the right upper quadrant of the abdomen. This was thought to be a distended gallbladder. There was generalized abdominal rigidity. Because of the possibility of acute obstructive cholecystitis exploration was performed. This revealed an acutely obstructed gallbladder with gangrenous cholecystitis but without stones. The liver, stomach, duodenum, pancreas and spleen were negative to palpation. The common duct was normal in size and seemed to contain no stones. The gallbladder was removed and a culture taken was reported as *Aerobacter aerogenes*. On the twelfth postoperative day the wound separated and was secondarily closed with through-and-through sutures. The patient was dismissed from the hospital one month after operation.

CASE 4—The patient, a white man, aged twenty seven years, from Central America, registered at the Clinic and was admitted directly to the hospital with the complaint of abdominal pain and jaundice of four days' duration. He stated that he had been in good health until June, 1945, when, four to five days after the repair of a right inguinal hernia, he had experienced an attack of sudden severe pain in the epigastrium and back. This had been relieved by morphine and until May, 1946, he had had no further trouble. At this time, while eating lunch, he was again seized with severe pain in the epigastrium. This lasted for five days and was accompanied by vomiting, fever, abdominal distention and slight jaundice. One month later roentgen colon were reported as normal. On July 19, 1946, a barium meal and follow-up film were reported as normal. This was followed by a rather experienced two attacks of abdominal pain. Four days before registration at the Clinic, following the drinking of whisky, he vomited. After this he had sudden severe epigastric pain with extension into the back, which lasted for three to four hours and was followed by residual soreness, dark urine and light stools.

On physical examination the patient was found to be a well-developed and well-nourished, jaundiced person in no acute distress. On abdominal examination the liver was enlarged, the gallbladder was palpable in the right upper quadrant, the common duct was dilated, the pancreas was palpable in the epigastrium, the spleen was not palpable, the stool was dark, the urine was dark, the blood was normal, the cholesterol was 18 mg, the sedimentation rate was 22 mm per hour, the prothrombin time was 18 seconds. Stools were negative for parasites and ova. The gastric contents showed a total acidity of 100 cc. 4 mg. per 100 cc. The common duct was dilated, the pancreas was palpable in the epigastrium, the spleen was not palpable, the stool was dark, the urine was dark, the blood was normal, the cholesterol was 18 mg, the sedimentation rate was 22 mm per hour, the prothrombin time was 18 seconds. Stools were negative for parasites and ova. The gastric contents showed a total acidity of 100 cc. 4 mg. per 100 cc.

bladder was found to be acutely inflamed. The common bile duct was dilated three to four times its normal size and the tail of the pancreas there was a small mass. The head of the pancreas was enlarged, the spleen was not palpable, the stool was dark, the urine was dark, the blood was normal, the cholesterol was 18 mg, the sedimentation rate was 22 mm per hour, the prothrombin time was 18 seconds. Stools were negative for parasites and ova. The gastric contents showed a total acidity of 100 cc. 4 mg. per 100 cc.

After division of the band, ileo ileostomy (side to side) was done with a Witzel type of enterostomy proximal to the anastomosis. The convalescence was then uneventful and the patient was dismissed on the thirteenth postoperative day.

COMMENT

Acute cholecystitis is, as has been well demonstrated by Womack, an obstructive phenomenon. Usually the cause is found to be an impacted stone at the entrance of, or in, the cystic duct. A study of the 102 cases seen at the Mayo Clinic from January, 1942, to December, 1946, inclusive, revealed that in only four cases was the obstructive component not due to this. Cases 1 and 4 illustrate the fact that obstruction of the common duct at the ampulla may be responsible for an obstructive inflammatory phenomenon in the gallbladder. In case 1 this was due to a carcinoma of the head of the pancreas and in case 4 to a stone impacted in the ampulla of Vater. In case 2 the only explanation of the obstruction seemed to be that inflammation involved the entrance of the cystic duct. The origin of this is obscure but in the absence of stones and without any dilatation of the common bile duct this must be the case. Case 3 is also one in which the obstruction was proved to result from inflammation. This was secondary to, or concomitant with, pancreatitis but was not due to occlusion of the common duct at the ampulla as is sometimes the case. It is my opinion that the acute pancreatitis was secondary to the known chronic cholecystic disease but that the acute obstructive gangrenous process in the gallbladder was due to an inflammatory occlusion of the cystic duct which accompanied or followed the acute pancreatitis.

SUMMARY

Acute obstructive cholecystitis is by name obstructive in character and in the great majority of cases is due to a stone being impacted at the entrance of the gallbladder. The process, however, may take place in the absence of cholelithiasis as is demonstrated by the four cases here presented.

TRANSURETHRAL RESECTION IN THE TREATMENT OF VESICAL DYSFUNCTION SECONDARY TO INFLAMMATORY, DEGENERATIVE AND TRAUMATIC LESIONS OF THE SPINAL CORD

JOHN L. EMMETT AND J. E. BISQUERTT

DURING the past few years much progress has been made in the care and treatment of neurogenic vesical dysfunction caused by trauma to the spinal cord.

bladder to empty its contents completely

NEUROPHYSIOLOGY

Before beginning the study of neurogenic vesical dysfunction, it is well to know as much as possible about normal vesical function. Unfortunately, our knowledge of normal micturition is incomplete and to some extent, theoretical. It is also rather ironical to note that most of the progress made in recent years in the study of the mechanics of normal micturition has been the result of study and treatment of neurogenic vesical dysfunction rather than the result of research on

the sympathetic nerve supply of the hypogastric or presacral ganglia (the first, second, third, fourth, fifth, sixth, seventh, eighth, ninth, tenth, eleventh and twelfth thoracic and first lumbar segments) has very little to do with the control of micturition. This nerve, however, contains sensory fibers which carry the sensations of pain and temperature and also exercise some control on the blood vessels in the wall of the bladder.

The important nerve supply of the bladder comes from the parasympathetic system by way of the pelvic nerves or *nervi erigentes* which originate from the second, third and fourth sacral segments. These nerves carry both sensory and motor fibers which supply the bladder and play the leading role in the mechanics of micturition.

There is a third set of nerves that apparently are involved in the act of micturition. These fibers are somatic and also originate from the second, third and fourth sacral segments. They pass via the pudendal nerve and supply the compressor urethrae muscle (external urethral sphincter). This muscle is regarded as a semivoluntary muscle.

MECHANICS OF NORMAL MICTURITION

Micturition may be regarded as the normal reflex response of the muscle fibers of the bladder to stretch.⁴ The sensory and motor fibers of the simple spinal reflex pass through the pelvic nerves. The reflex center is in the sacral portion of the spinal cord. This simple reflex arc for micturition is under the control of higher centers which constitute a suprasegmental conditioning reflex. As the bladder becomes distended with urine, the muscle fibers of the bladder are stretched, the natural response of which is reflex contraction. The contraction of the bladder is prevented by inhibitory impulses from the higher centers which act on the spinal reflex arc for micturition. These impulses are incited at a subconscious level by sensory stimuli which pass from the bladder up the sensory tracts of the spinal cord. When vesical distention reaches a certain degree, sensory stimuli are sufficient to reach the level of consciousness and are recognized as the "desire to void." This causes more inhibitory impulses to be sent down to the reflex center until the individual is ready to micturate, at which time he 'inhibits' the inhibitory impulses and allows the reflex vesical contraction to occur. If he does not wish to micturate and if vesical distention and the desire to micturate are great, he may voluntarily contract the external urethral sphincter. It is thought that this action may set up a secondary reflex which causes the bladder to relax. Munro¹⁸ summed up the present theory of micturition in a concise manner when he stated that it is a process of inhibition rather than one of facilitation.

RESULTS OF ANIMAL EXPERIMENTATION

The medical literature abounds with articles concerning vesical dysfunction following experimental lesions of the spinal cord. Much of the work is contradictory and is difficult to evaluate. In general, however, it seems to have been satisfactorily shown¹²⁻¹³ that two main types of vesical dysfunction are produced. One type results from completely severing the bladder from control of the central nervous system. This may be accomplished by (1) section of both pelvic nerves (nervi erigentes), (2) section of the anterior roots of both pelvic nerves, (3) destruction of the cauda equina, and (4) destruction of the conus medullaris (which contains the sacral segments of the spinal cord). In effect, this completely eliminates the spinal reflex. In such cases, vesical atony has passed, nonautomatic bladder. It has decreased capacity, (8) incontinence, (5) frequent

inefficient micturition

in some cases,

The second type results from lesions of the cord above the sacral segments. Theoretically, therefore, this should leave the simple spinal reflex arc for micturition intact. The type of bladder which results is called an "automatic bladder." It is characterized by (1) increased tone, (2) decreased capacity, (3) "active incontinence," (4) the presence of reflex vesical contractions, and (5) the presence of residual urine. The reflex contractions consist of more or less efficient contractions of the bladder which occur at more or less regular intervals. In the more efficient type, the interval between micturitions may be an hour or more, in which case a substantial amount of urine is evacuated at each micturition.

CLINICAL ASPECTS OF LESIONS OF THE SPINAL CORD

It is difficult and almost impossible to compare or correlate experimental lesions with lesions encountered clinically. Experimental lesions are definite and clean cut, and the exact condition of the cord above and below the lesion is known. In clinical practice, the opposite is true. The lesion may be complete or incomplete. It may involve one definite portion of the cord or a large segment of it. Although one usually can determine the upper level of the lesion, it is almost impossible to determine the condition of the cord below the lesion. These factors hold true whether the origin of the lesion is traumatic, inflammatory, congenital, neoplastic, or degenerative in character. For ease of presentation and description, the remaining consideration will be worded as though the lesions were traumatic unless otherwise indicated. The problem is essentially the same regardless of the etiologic factors involved.

TOPOGRAPHIC ANATOMY OF THE LUMBOSACRAL SEGMENT OF THE SPINAL CORD

It is not generally appreciated that all of the lumbar and sacral

in accidents it easily can be seen how one lesion can affect a considerable portion of the lumbosacral cord. Also, it is apparent how difficult it might be to decide from the neurologic examination of a patient with a lesion in this area whether the damage has included the spinal reflex arc for micturition or has left it intact.

GENERAL CONSIDERATION OF INJURY OF THE SPINAL CORD OF HUMAN BEINGS

Although until recent years little has been accomplished in the treatment of neurogenic vesical dysfunction, many accurate and competent observations concerning this subject have been made over a

period of many years. Many statements of authors such as Head and his associates, and Denny-Brown and Robertson³ are still regarded as accurate. A few of these statements may be of interest. These early workers observed the "shock phase" of vesical atony which appears immediately after injury of the cord and they noted that it persisted

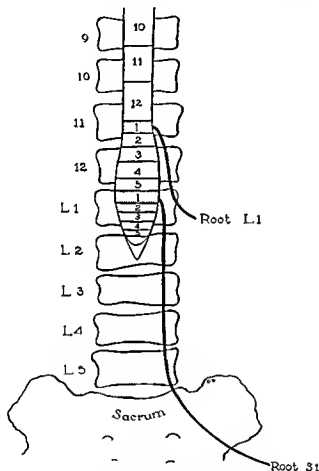


Fig. 305—Topographic anatomy of the spinal cord

for several weeks or months before the chronic stage of vesical dysfunction appeared. They accurately described this condition as one in which the vesical musculature is flaccid and allows the bladder to distend and overflow. Regarding the chronic stage of neurogenic vesical dysfunction, they observed that it was extremely difficult, if not impossible, to correlate the type of vesical dysfunction with the level

and type of the lesion of the cord. They were aware of the fact that it was difficult in many cases to distinguish an automatic bladder from a nonautomatic or autonomous bladder owing to the fact that the degrees of automaticity could vary so that the most inefficient types were difficult to distinguish from the autonomous bladder. They also knew that almost all cord bladders in the chronic stage carried substantial amounts of residual urine, which they rightly regarded as the causative factor in the lethal urinary infections which are responsible for most of the deaths in cases of transverse lesions of the spinal cord. Head, especially, demonstrated that in the chronic stage the bladder is usually hypertonic and trabeculated and that it is able by itself or with the assistance of the patient (straining with abdominal muscles or manual compression over the lower abdomen) to empty completely if a catheter is in place to overcome the resistance of the vesical neck and external urethral sphincter. These workers also observed that in cases in which the lesions are at a sufficiently high level in the cord and result in spastic paralysis of the lower extremities resulting mass reflexes seem to incite the automatic type bladder to more frequent contractions which result in a less efficient and annoying type of vesical dysfunction. These observations as well as others not mentioned form the basis for the modern treatment of neurogenic vesical dysfunction.

CLASSIFICATION OF CORD BLADDER

In spite of the recognized difficulties encountered in attempting to correlate the type of vesical dysfunction with the type and level of the lesion of the spinal cord many authors have attempted to devise classifications which will serve as a working basis for this difficult subject.^{16 18 20} One of the best and most complete classifications is that of Munro.¹⁸ He recognized five chief divisions which listed in order of lowest to highest type of vesical efficiency are as follows: (1) the atonic bladder (shock bladder) which occurs immediately after the injury to the cord; (2) the autonomous (nonautomatic bladder); (3) the hypertonic cord bladder; (4) the uninhibited reflex; and (5) the so called normal cord bladder. The atonic bladder persists for a varying length of time (from weeks to months) until the chronic phase of vesical dysfunction appears which accounts for the remainder of these types of vesical dysfunction. Although Munro stated that the gradual stages of improvement of vesical function depend chiefly on the degree of recovery of the spinal cord he stated

... of the cauda equina. Lesions situated above this level may permit establishment of one of the more efficient types of cord

bladder enumerated in Munro's classification depending on the level of the lesion and degree of recovery.

In our experience^{6, 10} the accurate classification of cord bladder is at best very difficult and seems to be of questionable value. Cystometry is apparently necessary to make a fine distinction between the various types. It is our opinion that there are so many extraneous factors in ordinary cystometric examination that too much reliance cannot be placed on it. We do feel, however, that simple methods of cystometry can help to distinguish an atonic bladder from a hypertonic bladder. Such distinction, however, can also be made by cystoscopy. It is our feeling that neurogenic vesical dysfunction can be divided into two types: (1) the atonic bladder and (2) the hypertonic bladder.

The *atonic bladder* is seen in two situations. It may occur immediately after injury of the spinal cord. In this case it is termed the "shock phase" of the cord lesion and the resulting vesical atony is termed "shock bladder." As mentioned previously, this condition lasts for weeks or months. The second condition in which neurogenic vesical atony is found is in cases in which only the sensory limb of the reflex arc for micturition is involved. Clinically, this condition occurs almost exclusively in cases of *tabes dorsalis*.

The *hypertonic bladder* accounts for almost all of the other forms of neurogenic bladder which would have a place somewhere in Munro's classification of autonomous hypertonic uninhibited reflex and so-called normal cord bladder. On the basis of our experience, the most practical attitude to assume is one in which two extremes of cord bladder are recognized. On the one hand is the most inefficient type of cord bladder called the autonomous; at the other extreme is the most efficient type of cord bladder which may be designated as the "automatic" type. This roughly corresponds to Munro's "hypertonic" or "uninhibited reflex" type of bladder. Between these two extremes are a host of intermediate conditions which may be difficult to classify. The autonomous type of bladder represents the condition which results when severe damage to the sacral segment of the spinal cord and the reflex arc has occurred. It is a bladder which frequently will evacuate small spurts of urine, keeping the patient continually wet but which will always contain a large amount of infected residual urine. The automatic type of bladder, on the other hand, is one in which fairly long intervals (up to three or four hours) may elapse between evacuations of urine. The amount of urine evacuated at each voiding may be considerable and the amount of residual urine usually is smaller than it is in the autonomous type of bladder. The patient also may have some warning that evacuation is about to occur so that sufficient time is allowed in which to procure a urinal to prevent the patient from soiling himself.

THERAPY OF ACUTE PHASE

Former Methods—There has been much disagreement of opinion in the past concerning the care of the bladder immediately after the onset of the lesion of the spinal cord. Even with all the experience encountered with this problem in World War I much difference of opinion was expressed in the literature by men interested in this problem.¹⁴⁻¹⁷ With the experience gained in the recent world war however opinion seems to have crystallized in this regard. One of the best considerations of this subject is that of Prather. He stated that two forms of treatment (1) intermittent catheterization and (2) the practice of allowing the bladder to overflow or to instruct the patient to employ manual expression of urine with suprapubic pressure are entirely obsolete.

Newer Methods—Prather suggested that the proper treatment should consist of continuous drainage provided either by an indwelling urethral catheter or a suprapubic cystostomy tube. When these methods are used the bladder is kept clean by means of a closed system of irrigation by either the intermittent or automatic (tidal) method. The choice of urethral or suprapubic drainage depends on various factors among which are (1) the facilities available for the care of the patient (2) the type of nursing service (3) urethral tolerance and (4) length of time drainage is expected to be necessary. Some patients are able to tolerate an 18 F bag urethral catheter for long periods of time with no untoward results. In other cases there is a tendency for urethral infection and periurethritis to develop; these complications may result in periurethral abscess (usually at the penoscrotal junction) and fistula. It is important to avoid such complications if possible as they greatly complicate treatment in the chronic stage. Administration of small doses of one of the sulfonamide drugs while a urethral catheter is in place will assist in the prevention of such complications. Each case must be considered individually however and final decision is a matter of keen judgment on the part of the physician.

The matter of the closed system of irrigation is important. Munro and Hahn have advocated the automatic (tidal) variety of irrigation. They and other authors have demonstrated that the urine may be

suprapubic tube)

suprapubic tube)

connector (fig 306). One arm of the Y or the inlet tube of the two way

the various closed types of
tent type of closed drainage
ther a two way catheter (or
attached to a glass Y con

catheter is attached to a bottle of irrigating fluid elevated at the side of the bed. At intervals, an attendant or the patient releases a clamp and allows fluid to enter the bladder. If a two way catheter is used the fluid runs out of the bladder as rapidly as it goes in. If a one way catheter is attached to the Y glass connector the outlet tube to the drainage bottle is clamped and the tube from the inlet irrigating bottle is unclamped until a certain amount of fluid enters the bladder. The procedure is then reversed allowing the bladder to empty.

The *automatic (tidal) type of closed drainage* was first described by Laver in 1917. It has been improved by Munro. Several modifications of the apparatus have been made among which may be men-

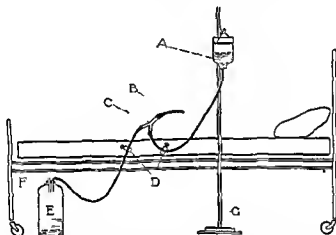
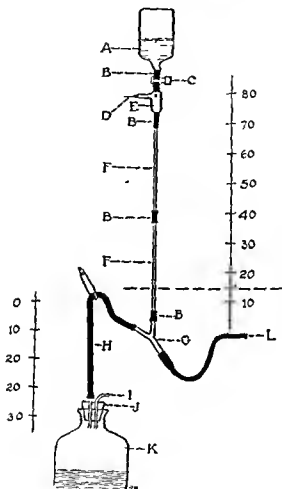


Fig 306—Manually controlled intermittent type of closed irrigation system. A Irrigation jar B To urethral catheter or suprapubic tube C Y glass connector D Screw clamps E Drainage bottle F Air vent G Stand for reservoir (After Prather G C Spinal cord injuries care of the bladder J Urol 57)

tioned those of MacNeill and Bowler Stewart and by Cone and Bridgers. Experience has shown that the more simple the apparatus can be made the more likely it is to function well and to be kept running satisfactorily by nurses and attendants. The apparatus devised by Cone and Bridgers is simple and has proved very satisfactory. It combines a tidal irrigator and cystometer as shown in figure 307. It will be noticed that the glass tubing that forms the manometer is divided into two pieces each 35 cm long to facilitate sterilization in a container of reasonable size. The height to which the apex of the siphon loop is raised above the bladder determines the pressure pro-



determines the maximal negative suction pressure that can be exerted on the bladder. This is lessened somewhat by the air vent valve. It is obvious that to perform cystometry with this apparatus it is necessary



Fig. 308 Tidal drainage apparatus used at the Clinic.

only to close off the siphon tube after the bladder has been emptied. It must be emphasized that the diameters of the tubing must be as described or the apparatus will become blocked with air and will not function properly.

An even simpler modification of the Cone and Bridgers apparatus has been found to be satisfactory (fig 308). It is almost identical with that of Cone and Bridgers with the exception that all of the glass tubing except the Y connection has been replaced by rubber tubing. The siphon tube is also of the same material and about the same caliber. It is important that it be of sufficient length to supply enough siphon pressure to empty the bladder completely. In all of the varieties of tidal drainage apparatus, the amount of fluid allowed to enter the bladder at each filling is regulated by intravesical pressure which is controlled by the height of the apex of the siphon tube (fig 308). When the intravesical pressure is equal to the distance in centimeters between the level of the pubis and the apex of the siphon curve, the siphoning action begins and empties the bladder before the action is interrupted. At this point, the bladder again begins to fill and the procedure is repeated.

THE THERAPY OF THE CHRONIC STAGE

The therapy of the chronic stage of the neurogenic bladder is primarily a problem involving the treatment of various types of hypertonic cord bladder. Almost the only exception to this statement is the atonic *tabetic bladder* which we are not considering in detail in this paper. This has been fully considered by Emmett and Beare. Suffice it to say that vesical dysfunction in the *tabetic* patient responds well to transurethral resection of the vesical neck. Briefly stated the *tabetic* bladder becomes atonic because block in the sensory limb of the reflex arc permits greater degrees of vesical distention to occur before the normal impulses get through to produce reflex vesical contraction. As a result of this vesical atony, minimal degrees of obstruction at the vesical neck are able to precipitate vesical decomposition with residual urine infection and overflow. Since most *tabetic* patients are more than forty years of age, some degree of prostatic enlargement is the rule in cases in which the patients are men. If the vesical neck is weakened by transurethral resection and the patient is taught to micturate at regular intervals using abdominal straining and manual compression if necessary, the bladder can be emptied completely at each micturition and the urinary infection can be eliminated. This allows the patient to lead a normal life as far as the urinary tract is concerned.

The remaining consideration, therefore, will concern the various types of *hypertonic neurogenic bladders* which constitute the overwhelming majority that are the end result of lesions of the spinal cord. These represent the so-called chronic phase of neurogenic vesical dysfunction or the chronic neurogenic bladder. It includes all types from the inefficient autonomous (nonautomatic) bladder through the various degrees of dysfunction to the more efficient automatic blad-

der It comprises the entire group of conditions which Munro classified as autonomous bladder hypertonic bladder, uninhibited reflex and so-called normal cord bladder

Former Methods of Treatment of the Chronic Neurogenic Bladder—Former methods of treatment of the chronic neurogenic bladder have been unsatisfactory About all that could be done for the autonomous type of bladder was to teach the patient to empty the bladder as completely as possible by means of abdominal straining or manual compression in order to secure a little longer interval between evacuations of urine The automatic bladder may respond a little better to treatment In the presence of more efficient types the patient recognizes some sensation or aura which indicates that vesical evacuation is about to occur so that a urinal can be procured in time to prevent soiling Some patients are able to detect a "trigger area" which if stimulated will initiate micturition if the bladder is reasonably distended with urine In cases of efficient automatic bladders in which there is a reasonably long interval between evacuations of urine the patients may be handled fairly well In the cases in which the bladder is irritable and urine is passed irregularly there was nothing to offer aside from a rubber urinal indwelling catheter or suprapubic tube

Newer Methods of Treatment—During the last decade there has been a gradual evolution in thought concerning the problem of cord bladder To follow the line of reasoning involved it is necessary to understand a few basic concepts of this condition There are certain common characteristics of all cord bladders (if lesions involving only the sensory portion of the reflex arc are excluded) These are (1) increased tone of the bladder (2) presence of residual urine and (3) "active urinary incontinence of some type

In every case of true cord bladder there are *increased tonicity* and *increased thickness* of the detrusor urinae muscle In some cases this condition is extremely marked and results in a spastic bladder Observations suggest that the autonomous or least efficient type of bladder may be the seat of greater tonicity and hypertrophy of the detrusor urinae muscle than the more efficient automatic type of bladder Trabeculation is a prominent finding in all cases of cord bladder The degree of trabeculation and the caliber of the trabeculae vary greatly

As stated previously in all (or nearly all) cases of true cord bladder there is *residual urine* Munro has expressed the values for residual urine in terms of per cent of the "fill" (vesical capacity) Expressed

"Incontinence" is a term that is badly used in the urologic literature. It has been used to describe every type of condition, from complete passive urinary leakage to marked "urgency" of micturition. In most cases of true cord bladder, incontinence is not manifested by a passive continuous dribble of urine similar to that which is noted when the external urethral sphincter has been destroyed. Rather, it consists of intermittent spurts of urine which are evacuated by more or less inefficient vesical contractions. This evacuation of urine varies from frequent spurts of small amounts by the inefficient autonomous type of bladder to the sudden precipitate evacuation of more substantial amounts of urine with little or no warning at reasonably long intervals by the more efficient reflex vesical contraction of the automatic type of bladder.

Inasmuch as a cord bladder has increased tone and muscular strength, it never has been entirely clear why such a bladder should not be able to perform a better job of evacuating its contents than it does. The best explanation available supposes the reason to be the inefficiency of the vesical contractions. This is especially true of the autonomous type of bladder which is completely severed from nervous connection with the spinal cord.

Spasms occur, but rather autonomous supposedly by reflex centers.

The persistence of residual urine is still more difficult to explain in the case of the "automatic" type of bladder in which the reflex arc is intact. To assist in the explanation the analogy of the infant's bladder has been given. For instance, in the case of the newborn infant there is no voluntary control over micturition. Micturition is entirely reflex in type, yet the bladder empties completely at each evacuation. To explain this, it is supposed that the brain stem is a center in the brain which causes the bladder to contract sufficiently to expel its contents completely.

In the infant, whose pyramidal tracts are unmyelinated, the so-called reflex type of bladder empties completely because the afore mentioned center in the brain stem is intact and the impulses can get through extrapyramidally. In the case in which the spinal cord has been transected, it is supposed that these impulses cannot get through.

A more attractive and plausible theory suggests that the vesical

developed a method whereby removal of this obstruction at the vesical neck could be accomplished. This accounts for the fact that

the modern progress in the treatment of cord bladder closely parallels the evolution and development of transurethral resection

Our early experience in this field was with patients who had incomplete transverse lesions of the cord from which they had partially recovered over a period of several years. In most instances, the patients had been left with varying degrees of spastic paralysis of the lower extremities with the typical spastic deformities, drop foot and so forth, but sufficient recovery had occurred so that by means of crutches or canes the patients were ambulatory with some type of spastic gait. In most instances, these patients were resigned to the partial paralysis and had learned to get along reasonably well in this regard. The chief symptom was nearly always related to the urinary tract and they complained bitterly of urinary incontinence. When they were closely questioned, it would be found that there was no true incontinence, but rather a severe precipitate type of urgency incontinence of such a degree that the patient was unable to reach a toilet. For this, it was necessary to employ a rubber urinal. It was also observed that nearly all patients carried several hundred cubic centimeters of residual urine. Quite by accident, we discovered that after the bladder had been emptied completely with a urethral catheter the patient would remain dry and have no more emissions of urine until an amount equal to the amount of residual urine had again accumulated in the bladder. We also observed at cystoscopy that these patients invariably had marked trabeculation of the bladder, increased expulsive force and varying degrees of contraction and fixation of the vesical neck. In some cases, there seemed to be an actual collar of tissue around the vesical neck, apparently the result of hyperplasia of muscle in this region. Cautiously, we began to perform transurethral resection on some of these patients with most spectacular results. The following case is illustrative.

CASE 1—A white man, aged thirty six years, registered at the Mayo Clinic. Nine years previously he had sustained fracture of a vertebra in an automobile accident. Complete paralysis of the lower extremities and complete retention of urine had resulted. The patient gradually had recovered some degree of control of his lower extremities but had continued to employ routine catheterization for seven years.

At the time he came to the Clinic, the patient was able to walk with a cane. His chief complaint was marked urinary urgency and frequency, with partial urinary incontinence. Incontinence consisted of precipitate micturition before the patient was fully aware of it and could reach the toilet. Neurologic examination revealed partial paralysis of lower extremities, with marked diminution in sensation of touch and pain. The lesion was at the level of the twelfth thoracic segment of the spinal cord.

Cystoscopy disclosed trabeculation of the bladder, grade 1, on a basis of 1 to 4 in which 1 represents the least and 4 the most trabeculation. About 300 c.c. of residual urine was present. It was noticed that, after the bladder had been emptied with a catheter, the patient would remain dry and would not experience

frequency or precipitate micturition for at least five hours. Transurethral prostate resection was performed, and 3 gm. of tissue was removed. The pathologist reported this material to be smooth muscle and inflamed tissue. The result of this procedure was excellent. The patient was able to void a satisfactory stream of urine and had neither residual urine nor urinary incontinence.

EXPERIENCE WITH TRANSURETHRAL RESECTION IN SIXTY-FIVE CASES OF NEUROGENIC BLADDER PRIOR TO JANUARY, 1946

The successful results of transurethral resection of the vesical neck on ambulatory patients with incomplete lesions of the spinal cord and partial recovery stimulated us to extend our investigation to bedridden patients with complete lesions and also to patients with miscellaneous lesions of the spinal cord such as multiple sclerosis, combined sclerosis and degenerative lesions of the cord. The results have been more than encouraging. We now feel that this operation should be performed routinely for these conditions. A summary of our experience up to January, 1946, is illustrative of the general problem.

A total of sixty-five patients with chronic cord bladder have undergone transurethral resection at the Clinic prior to January, 1946. Forty-five of these patients had transverse lesions of the spinal cord, while the remaining twenty had other lesions of the spinal cord, such as multiple sclerosis, combined sclerosis and miscellaneous lesions. The most interesting group is the forty-five patients who had transverse lesions of the cord. This group will be considered first.

Data Concerning Transverse Lesions of the Spinal Cord.—It is of interest to know the *causative factor* involved in the forty-five cases of transverse lesions. In twenty-four cases the lesion was the result of trauma, in ten it followed inflammatory lesions, in five it occurred after operation for a tumor of the spinal cord, and in the remaining six, it apparently was a sequela of spinal anesthesia. The *duration of the lesion* also is of interest. The interval of time that had elapsed since the occurrence of the lesion of the spinal cord varied from four months to forty-six years. Forty of the patients were men and five were women. Twelve of the patients were bedridden, nine were ambulatory with the aid of crutches or canes, while twenty-four were ambulatory without the use of crutches or canes but exhibited varying degrees of the characteristic spastic gait seen in cases of this condition. The *site of the lesion* was as follows: cervical segment of the cord in three cases, upper part of the thoracic segment in five cases, lower part of the thoracic segment in nine cases, lumbar segment in eleven cases.

vealed bilateral ureterectasis in six cases and unilateral pyelo ureterectasis in two cases in the remaining seventeen cases it did not disclose any abnormality

The type of vesical dysfunction observed in the forty five cases is interesting. Generally speaking it was practically impossible to make any correlation between the type of vesical dysfunction and the site of the lesion in the spinal cord. It may be that the reason for this was that the group is too small to have any substantial number of lesions appear at any one level. As the literature accumulates on this subject a more definite correlation may be possible. The vesical symptoms in this group of cases varied tremendously. In some cases there was complete retention of urine with overflow dribbling and the patient did not experience any discomfort or desire to micturate until the bladder was markedly distended and palpable above the umbilicus. At this stage varying degrees of discomfort would be noted and overflow dribbling of urine would occur.

The type of vesical dysfunction most frequently seen among the patients who had complete or almost complete paralysis seemed to be that in which more or less frequent emissions of varying amounts of urine took place without the patient's knowledge of the act. In some cases this may occur every ten to twenty minutes whereas in other cases the interval may be an hour or longer. In some of the cases in which there was an interval of one to three hours between evacuations of urine the patient might pass in addition an occasional small spurt of only a few cubic centimeters of urine. This usually occurred near the time at which evacuation of the urine was about to occur. In almost all of these cases if the bladder was emptied with a catheter voiding or leakage of urine would not occur until an amount of urine equal to the patient's residual urine again had accumulated in the bladder. In most of these cases the amount of residual urine varied from 200 to 500 c c.

A rather characteristic type of vesical dysfunction is seen among patients who have achieved rather marked recovery from paralysis and have become ambulatory. This kind of dysfunction can be described as a precipitate type of urgency incontinence. The patient is suddenly seized with a desire to micturate. The basis of this desire may vary from a normal sensation to some odd "aura" such as an ache in the abdomen or some type of paresthesia in the perineum or thighs. The patient is then unable to reach a lavatory before the urine is evacuated. Such patients always have a substantial amount of residual urine. They describe their condition as urinary "incontinence" for which they are forced to wear a rubber urinal. The condition is doubly disturbing to the patient because there is not a sufficiently regular interval between micturations to allow him to be near a lavatory and anticipate the act.

In cases in which the injury of the spinal cord is a result of administration of a spinal anesthetic agent, the vesical dysfunction is interesting. In some cases the dysfunction amounts to complete retention of urine, the patients are unable to micturate and pain occurs when the bladder becomes distended. In other cases, the patient is able to micturate, but considerable abdominal straining is required and the bladder cannot be emptied. In still other cases, the disability is more like the precipitate type of urgency incontinence described previously.

Trabeculation—We never have seen an instance of true cord bladder (in which a sufficient length of time had elapsed for the patient to recover from the shock stage) that was not accompanied by trabeculation. The trabeculation varies greatly in degree, as does the size of the trabeculae. The old idea that fine trabeculation denotes a neurogenic bladder and that coarse trabeculation signifies obstruction at the vesical neck is entirely erroneous.

Tonicity of the Bladder—It has been our experience that practically all true cord bladders exhibit an increase of tone in the detrusor urinae muscle. This of course is not true when only the sensory components of the reflex arc have been damaged (as is the case in *tabes dorsalis*) or in the occasional rare case in which for some reason or other, the sensory components are primarily affected. One characteristic type of cystoscopic appearance of the true cord bladder is the more or less constant "writhing" appearance of the bladder, which appears constantly to be undergoing irregular contractile efforts which may make satisfactory distention with water through the cystoscope rather difficult.

Condition of the Vesical Neck—If the vesical neck is kept under observation during these contractile efforts of the bladder, it will be noticed that the vesical neck also undergoes more or less the same

associated. In some cases the vesical neck appears to have a "collar" of tissue surrounding it and has much the same appearance as a collar of adenomatous tissue. Among older patients in addition varying degrees of prostatic hyperplasia may be present. Massive hypertrophy of the interureteric bar also is a common observation.

In some cases, the degree of spasticity and hypertrophy of the bladder may be minimal and it may be difficult to demonstrate a contraction or collar at the vesical neck. Thompson²⁴ has suggested that in these cases, if the bladder be well distended with water, a prominent contraction ring at the vesical neck will become apparent. If a contraction, spasticity or collar obstruction at the vesical neck is not demonstrable to the satisfaction of the cystoscopist, it is unimportant

so far as diagnosis and treatment are concerned. Resection of the vesical neck will yield good results in spite of the cystoscopic appearance of the structures, and the obstruction often will not become apparent until after resection has been started.

Transurethral Resection of Vesical Neck—All of the transurethral resections in this series of cases were done with the Thompson cold punch with the usual technic.² The object of the operation is to remove the vesical neck (so called internal urethral sphincter) and any prostatic enlargement present. The resection must be complete and should be carried out to the region of the external urethral sphincter. If the external sphincter is not damaged, incontinence will not result. It has been our experience that the resection must frequently be done in multiple stages. Although the surgeon may feel sure that the resection has been complete, he will often find on subsequent examination that as much or more tissue can again be removed. It is wise to perform the resection in multiple stages in some instances because, if one tries to resect too deeply in the muscular tissue at the vesical neck at the first stage, troublesome bleeding may be encountered and may prove difficult to control. In this series of forty five cases, the resection was done in one sitting in thirty four cases, in two stages in seven cases and in three stages in two cases and in four stages in two cases. The amount of tissue removed is usually rather small unless the patient is an elderly person. Young patients who have been present for many years may have a large amount of tissue at the vesical neck. In one case, a patient twenty five years of age had sustained a traumatic lesion of the cord nine years previously; a total of 20 gm of tissue was removed. In the series of forty five cases under consideration, the amount of tissue removed varied from 1 to 34 gm.

The results of transurethral resection in these forty five cases was gratifying. Excellent results were obtained in thirty two cases, in seven cases the patients were greatly improved, in two cases fair results were obtained and in four cases the patients were unimproved. It should be remembered that these cases embrace the entire period during which we were feeling our way and learning the principles of treatment of this disease. We believe that our present results (owing to our increased knowledge of this problem and improvement in technic) are considerably better than these figures would indicate. The following case abstracts illustrating the various types of conditions treated should be helpful in clarifying this new and rather complex therapeutic problem.

CASE 2—This case represents long standing incomplete injury of the cervical part of the spinal cord with almost complete recovery except for the bladder. A man forty-eight years old came to the Clinic on April 16, 1945. He had sustained a fracture of the fifth cervical vertebra in 1922. Complete quadriplegia had en-

sued and had persisted for thirty days. Gradual recovery had followed, until the only residual effect was numbness and some degree of weakness in the legs and slight drop foot on the right side. The patient was unable to ejaculate semen. The abdominal muscles were normal and the gait was almost normal. The patient had difficulty in voiding urine and the stream was poor. Nocturia was present and the bladder contained 250 cc of residual urine. Cystoscopy disclosed trabeculation, grade 1, and a typical collar or contracture of the vesical neck. Transurethral resection was performed on May 22, 1945, and 3 gm of tissue was removed. The pathologists reported adenofibromatous hyperplasia. The results of operation were good. The urinary stream was excellent. There was no residual urine. Vesical control was good.

CASE 3—This case represents an incomplete traumatic lesion of the conus medullaris and cauda equina. A young man, thirty-two years of age, came to the Clinic in June, 1940. Three years previously he had fallen from a building and fractured the first lumbar vertebra. Complete paralysis of the lower extremities had occurred immediately. He had been confined to bed for five months. After the injury he had been catheterized for about two weeks. He gradually had recovered from the paralysis. When he came to the clinic he was able to walk with a shuffling spastic gait with the aid of a cane. The chief complaint was urinary incontinence and recurring chills and fever. The incontinence consisted of precipitate urgency of micturition. The patient was never sure when this would occur and could not reach a toilet before micturition occurred, therefore, he wore a rubber urinal. Neurologic examination revealed residual saddle anesthesia and anesthesia which involved areas supplied by the fifth lumbar segment and the third, fourth and fifth sacral segments on the right side and by the first, third, fourth and fifth sacral segments on the left side. Urologic examination revealed infected urine and pyuria, grade 4. Excretory urography revealed bilateral hydronephrosis, grade 3, and marked reduction in renal function. The bladder contained from 100 to 300 cc of residual urine. A retrograde cystogram revealed reflux of urine, grade 4 in the right ureter. Cystoscopy revealed trabeculation grade 2, and considerable fixation of the vesical neck. Treatment at first was conservative. The patient was taught to void regularly by using abdominal and manual pressure, but this produced a recurrence of the chills and fever, apparently due to the reflux. Suprapubic cystostomy was performed in July, 1940, and the patient wore a suprapubic tube for one year. One year later, a urogram showed marked improvement of the kidneys. Transurethral resection of the vesical

neck was performed and 4 gm of tissue was removed. The results of operation were good. The urinary stream was excellent. There was no residual urine.

CASE 4—This represents a long-standing incomplete lesion of the conus medullaris and cauda equina.

distention of the urinary bladder. Neurologic examination disclosed saddle anesthesia involving the areas supplied by first and second lumbar and the third,

fourth and fifth sacral segments. There was absence of rectal tone and the ankle jerks were gone.

An excretory urogram revealed dilatation, grade 2 of both ureters. The bladder contained more than 300 cc of residual urine. After the patient was catheterized and the bladder emptied, she remained perfectly dry without incontinence until the bladder contained from 100 to 180 cc of urine. Cystoscopy revealed trabeculation, grade 1, of the bladder. The urethra was very short. Transurethral resection was performed on July 2, 1945. One gram of tissue was removed from the entire circumference of the vesical neck. Microscopic examination showed that it consisted of inflamed muscle. The postoperative result was excellent. The patient voided satisfactorily, her bladder contained less than 15 cc of residual urine and she did not wet the bed at night.

CASE 5—This is a case of traumatic lesion of the conus medullaris in which the recovery was satisfactory except for the vesical dysfunction. A woman, thirty-four years of age, came to the Clinic on October 9, 1945. She had sustained a fracture of the first lumbar vertebra in 1939. Loss of control of the bladder and rectum and a 50 per cent loss of sensation and motor power of the lower extremities had ensued. The motor and sensory disturbances had gradually disappeared, but disturbance of control of the bladder and rectum had continued. The patient complained of constant leakage of urine at night. She had an almost constant "bearing-down sensation" and a desire to micturate in the daytime. She passed only small amounts of urine. She catheterized herself often, and would obtain more than 300 cc of residual urine.

and dry.
The motor
dominal

300 cc of residual urine increased expulsive force and a very short urethra. The first stage of transurethral resection was performed on October 15, 1945, during which seventeen pieces of tissue weighing a total of 2 gm, were removed. The operative result was poor. The second stage of transurethral resection was performed on October 24, 1945, during which twenty-two pieces of tissue weighing a total of 2 gm were removed. The pathologic report on tissue removed at both operations was "inflamed muscle." The operative result was good. The urinary stream was satisfactory and there was no residual urine. Nocturia was noticed once. Vesical control was good.

Concrete lesion of the lower thoracic portion of the lower extremities. The patient had incontinence. A man, twenty-nine years of age. Three years previously he had sustained complete motor paralysis and loss

of sensation in the lower extremities. The patient had had no control of bladder or bowels since the injury. Neurologic examination disclosed flaccid paralysis of the lower extremities. The sensory level was at the twelfth thoracic segment. The upper abdominal muscles were normal, in the lower abdominal

tissue was removed. The pathologic report was adenofibromatous hyperplasia. The operative result was good. Improvement was slow but gradual. In answer to a follow-up letter sent to the patient three months after operation, he said he was able to empty his bladder completely, except for 10 to 20 c.c. of residual urine, he voided every two hours, he strained the abdominal muscles to void but had a satisfactory stream. He was able to keep perfectly dry.

CASE 7—This case represents a complete traumatic lesion of the lower thoracic part of the spinal cord with complete spastic paralysis. There was no recovery from paralysis of extremities. A man, twenty-seven years of age, came to the Clinic on June 22, 1915. He had been injured in a mine accident in May, 1911. Complete paralysis of the lower extremities had ensued. Laminectomy had been performed twenty-four hours later. Use of an indwelling urethral catheter for two months had been followed by severe urinary infection and bilateral epididymitis. Suprapubic cystostomy had been performed. The patient arrived at the

clinic with a suprapubic catheter. The suprapubic wound closed in five days. The urethral catheter was then removed and vesical function was observed. After catheterization, the patient would remain dry for about one hour without leakage, then frequent spurts of urine at irregular intervals would keep the patient wet. Residual urine amounted to 350 c.c. Cystoscopy disclosed trabeculation, grade 3. The detrusor urinae muscle was spastic, the vesical neck was very spastic, with an apparent collar of tissue. A transurethral resection, which was performed, was removed. The operative result was good. The patient could sense a

amount of urine as much as 250 c.c. and was able to void with the use of a signaling gait. He could put on his braces, get up from the floor alone, climb stairs and get in and out of an automobile.

Examination disclosed an intraspinal lesion and marked damage to the motor roots. The sensory level was at the fourth or fifth lumbar vertebrae. The abdominal muscles were normal. Excretory urography revealed marked delay in visualization of the contrast medium and bilateral hydronephrosis, grade 2. Cystoscopy disclosed trabeculation, grade 3. The detrusor urinae muscle was spastic and there was marked spastic contraction of the vesical neck. At transurethral resection, which was performed on September 20, 1915, 2 gm. of tissue was removed.

The pathologic report was hypertrophied muscle. Residual urine persisted after this operation. At subsequent transurethral resection, which was performed on September 28, 1945, 4 gm of tissue was removed. The pathologic report was adenofibromatous hyperplasia. Residual urine also persisted after this operation. An episode of acute pyelonephritis occurred. Another transurethral resection was performed on October 15, 1945, and 5 gm of tissue was removed. The pathologic report was adenofibromatous hyperplasia. The operative result was good. The patient was able to empty his bladder completely, and voided every two to three hours. He strained with the abdominal muscles and employed manual compression. The urinary stream was satisfactory. The patient could remain dry. An answer to a follow-up letter three months later indicated that the patient was well and that his urine was clear.

CASE 9—This case represents an incomplete lesion of the lumbar cord following continuous spinal anesthesia for an abdominal operation. A man, aged sixty-one years, came to the Clinic in February, 1944. Two years previously, gastric resection had been performed with continuous spinal anesthesia. After

revealed that the urine was essentially normal. The bladder contained 60 c.c.

stream had no residual urine and could retain his urine for two to three hours and did not have any leakage. The nocturnal incontinence disappeared.

CASE 10—This case represents a complete transverse lesion (traumatic)

twelfth thoracic segment had occurred and the patient had not recovered. Roentgenographic examination disclosed compression of the twelfth thoracic and the first lumbar vertebrae. Neurologic examination showed that the sensory level was at the twelfth thoracic vertebra. There was a flaccid paralysis of the lower extremities and considerable atrophy. The bladder was evacuating urine irregularly every few minutes. After the patient had tried to empty the bladder, catheterization disclosed 130 c.c. of residual urine. After catheterization the patient would be comfortable and remain dry until the bladder contained 130 c.c. of urine after which time urinary spasm would occur frequently. The patient complained of distress in the region of the bladder. Excretory urography showed that the upper part of the urinary tract was essentially normal. Cystoscopy revealed trabeculation grade 1. The vesical neck was moderately contracted. Transurethral resection was performed and a total of 4 gm of tissue was removed from the entire circumference of the vesical neck. The pathologic report was adenofibromatous hyperplasia. The postoperative result was good. The patient voided every hour with warning. The warning consisted of a suprapubic feeling of desire to void. The urinary stream was good, it was necessary for him to void only once at night and he was able to empty the bladder completely.

CASE 11—This case is representative of a war injury (bullet wound) in the thoracic portion of the spinal column, producing a complete lesion with no

after the patient's injury and had been left in place for eight months, after which it had been removed. The wound had been allowed to close. When we saw the patient he voided every two to two and a half hours. He had a sensation of fullness over the lower part of the abdomen before micturition would occur. He remained dry in the meantime. Residual urine amounted to 400 c.c. Neurologic examination disclosed complete spastic paralysis of the lower extremities. The sensory level was at the eighth thoracic segment. The upper abdominal muscles exhibited loss of strength, grade 2. There also was loss of strength, grade 4, in the lower abdominal muscles. Cystoscopy disclosed trabeculation, grade 2. The detrusor urinae muscle was spastic. At transurethral resection, which was performed on December 10, 1945, 4 gm of tissue was removed. The pathologists reported adenofibromatous hyperplasia. The operative result was good. The patient voided every two hours and the amount of residual urine was less than 50 c.c. The patient sensed a warning when he was ready to micturate. He was able to remain dry.

of the 45th cervical
recovery of
ies A man,
September,
1946

months after the injury. At the time we saw the patient, he was wearing a urinal constantly. The bladder expelled its contents about every hour. The bladder contained 120 c.c. of very foul thick residual urine. The patient experienced a feeling of flushing and perspiration before voiding occurred. Neurologic examination disclosed spastic paralysis of the lower extremities but partial function of the arms remained. The sensory level was at the fifth cervical segment. The abdominal muscles were completely paralyzed. Excretory urography disclosed a stone in the upper third of the right ureter and absence of function in the right kidney. The left kidney was normal. Cystoscopy revealed trabeculation, grade 3. Marked hypertrophy of the wall of the bladder was noted. At transurethral resection, which was performed on October 29, 1945, 7 gm of tissue was removed. The pathologists reported adenofibromatous hyperplasia. After the operation, the residual urine amounted to 400 c.c. At subsequent transurethral resection, which was performed on November 14, 1945, 6 gm of tissue was removed. The pathologists reported inflamed muscle. After this operation, 300 c.c. of residual urine persisted. When a third transurethral resection was performed on January 9, 1946, 5 gm of tissue was removed. The pathologists reported inflamed muscle. A fourth transurethral resection was carried out for the removal of tissue was removed. The pathologists reported inflamed muscle. The patient still was under observation every hour. Much perspiring occurs. Residual urine now has been reduced to 200 c.c. and seems to be gradually

When Should Transurethral Resection Be Done?—Thus far, we have spoken only of transurethral resection for the treatment of the chronic phase of cord bladder. The question naturally arises as to how soon the chronic phase of neurogenic vesical dysfunction begins following the onset of a lesion of the spinal cord. How long does the atonic shock phase of vesical dysfunction last? How can one determine when transurethral resection should be carried out? In what proportion of cases of lesions of the spinal cord should transurethral resection be necessary?

The atonic shock phase of neurogenic vesical dysfunction apparently can last for a few days or several months. An excellent account of this phase of the disease has been given by Prather. In a series of cases of injury of the spinal cord which this author observed during World War II the duration of this phase was five months in cases in which the injury had traversed the cord completely and three months in cases in which it had traversed the cord partially. The recovery of vesical tone was determined roughly by cystometric methods. If the lesion of the cord is incomplete the rate and degree of recovery are extremely variable and it is almost impossible to determine when maximal degree of recovery has occurred.

Theoretically it would be desirable to postpone transurethral resection until the vesical dysfunction had reached its final chronic stage. If this could be done maximal detrusor tonicity probably would return and almost the maximal degree of spasticity and contracture of the vesical neck would occur before transurethral resection.

Prather that surgical treatment should be postponed until the patient is in good general condition and until the decubitus ulcers are well controlled. It would also be desirable to await some return of vesical tone.

Whether or not one should wait longer than three or four months for this to occur is doubtful however. We do not feel that cystometry is of much value in foretelling whether a bladder will respond well to the patient's attempt to micturate either with or without transurethral resection. In cases of autonomous or nonautomatic bladder, the patient depends to a large extent on abdominal pressure to evacuate the urine therefore vesical tone may not be so important as it for-

It is a controversial subject at the present time as to what percentage

of injuries of the spinal cord will require transurethral resection to establish satisfactory vesical function. For instance, Prather, in his series of 61 cases of injuries of the spinal cord observed in an army hospital during the recent war, performed transurethral resection in only one case. On the other hand Bumpus, Nourse and Thompson, in a similar series of cases observed in a navy hospital, found it necessary to perform transurethral resection in fifty-eight of 101 cases. It is our feeling that even a higher percentage of patients may eventually require transurethral resection. In many cases in which patients are able to empty their bladders satisfactorily without transurethral resection a few months after the injury, more spasticity and contraction of the vesical neck may develop later and increase the amount of residual urine and the infection.

Data Concerning Patients with Multiple Sclerosis and Miscellaneous Lesions of the Spinal Cord.—In studying a group of cases such as this, one is confronted with a group of patients who have some lesion of the spinal cord other than a true transverse lesion. This comprises a rather miscellaneous group. In some of these cases, as for instance cases of multiple sclerosis, there is no question that the neuro-vesical dysfunction. In other the patients are old, it may be that the vesical dysfunction is primarily neurologic, obstructive or a combination of both. After discarding all cases in which it was felt that the neurologic lesion was of little or no importance, twenty cases, remained for consideration. The neurologic diagnosis in these twenty cases was as follows: multiple sclerosis in seven cases, combined sclerosis in five cases, arachnoiditis (which had been explored surgically) in three cases, degenerative lesions of the spinal cord in two cases, amyotrophic lateral sclerosis in one case, diabetic neuritis in one case and old arsenphenamine myelitis (?) in one case.

Patients who have multiple sclerosis present a particularly interesting problem. It is well known that the characteristics of this disease are that the lesions are disseminated in time and space. In some cases the vesical dysfunction is not in severity but in the character of the stream of micturition, a poor, interrupted stream and uncertainty in initiating the stream. When the condition is more advanced, the patient may complain of a pre-urinary urge, the after-drib, or the patients carry a substantial amount of residual urine and may have the usual complications such as urinary infection and vesical calculi. Of

these seven patients who had multiple sclerosis, six were men and one was a woman. Three of the patients were less than forty five years of age. All but one patient had more than 120 cc of residual urine. The results of transurethral resection in this group have not been as consistently good as the results in cases of transverse lesions of the spinal cord. Three patients obtained good results and in the other four cases the results were only fair. Resection was done only once in each of the four cases in which the results were fair, therefore it is entirely possible that further resection might have been beneficial as is so often true in cases of transverse lesions. A brief report of two cases will illustrate the problem involved.

CASE 13—This case represents urinary dysfunction associated with multiple sclerosis. The patient came to the Clinic in April 1945. She stated that at which time a diagnosis of multiple sclerosis was made. At the time she came to the Clinic her chief complaint was urinary dysfunction. Her urinary dysfunction had been gradually increasing in severity for the past two years. In addition she had been having some difficulty in evacuating her stools. She stated that it was difficult to start the urinary stream and after it was started it was difficult for her to maintain it without a good deal of abdominal straining. Neurologic examination

In April 1945 a transurethral resection of the vesical neck was performed and seventeen pieces of tissue were removed from the entire circumference of the vesical neck.

After the operation the patient had no difficulty in passing her urine and it was necessary for her to strain to micturate. However she had no residual urine and microscopic examination of the urine did not disclose any abnormality. It was felt that she was not having enough trouble to warrant further transurethral resection.

CASE 14—This case is representative of vesical dysfunction associated with multiple sclerosis. Relief was achieved by transurethral resection. A man forty one years of age came to the Clinic on February 1, 1945. He gave a history

to less than 50 c c There was no urinary frequency

Other Lesions of the Spinal Cord—Of the other miscellaneous lesions of the spinal cord combined sclerosis is of the most interest Transurethral resection was performed in five cases of this condition and the results were good in four cases Of the remaining eight cases the results of transurethral resection were good in five and poor in three It should be noted that all of these patients with miscellaneous lesions were of an age at which prostatism might be expected to occur therefore it is difficult to state what proportion of their condition was due to an enlarged prostate gland and what proportion was caused by the neurologic lesion The important point to be learned from these cases however is that combined sclerosis does not constitute a contraindication to the performance of transurethral resection when this procedure is necessary to relieve symptoms of urinary obstruction

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SURGERY OF THE PERIPHERAL NERVES: PRACTICAL CONSIDERATION OF MODERN TECHNIQS

GEORGE S BAKER

THE current improvements in the repair of a severed peripheral nerve are perhaps the result of early suturing of the nerve by better trained surgeons. Many new methods were developed during the medical emergency of World War II but it is safe to say that there is no method of clinical value which can replace a good end to end anastomosis. Fads and fancies come and go, but the fundamental principles of nerve surgery have changed very little in the past thirty years.

EARLY ANASTOMOSIS

Most neurosurgeons advocate early exploration and end to end suture of a severed nerve.^{7, 8, 16} It is obvious that few surgeons have the ability or clinical judgment always to distinguish those nerve lesions that are capable of spontaneous recovery from those that require neurorrhaphy. If the nerve is visualized during the primary debridement and found to be severed, end to end anastomosis should be attempted as soon as possible. Chemotherapy has hastened the safe period for exploration in compound injuries when damage of bones, tendons and nerves is apparent. During the various stages of nerve degeneration and regeneration the normal changes necessary for repair are naturally better suited for early anastomosis. The proliferation of Schwann cells is at a maximal degree of activity about the third week after the injury and since the satisfactory repair of the nerve is so dependent on this phenomena, it seems likely that early suturing will be advantageous for the best results. The time element is very important in reducing the period of disability. Other important factors play major roles in the functional recovery of a nerve. Serious damage to the vascular supply of an extremity is likely to be associated with marked fibrosis of the distal muscles as well as the end plates of the nerve. When the nerve is damaged in combination with a marked atrophic extremity, failures or poor results will be noted even though the nerve anastomosis is performed by an experienced neurosurgeon. The application of splints to the paralyzed extremity and active or passive motion must be supervised very carefully as these important adjuncts to the surgical procedures often may be abused rather than used to good advantage. In general, it must be admitted that when a nerve is completely severed, an early anastomosis by end to end suturing is the procedure of choice. If the nerve is

not severed some valuable information is often gained and little harm will be done if early surgical exploration is done by a competent surgeon

SURGICAL PROCEDURES

The most common surgical procedures that are used in the repair of peripheral nerves are neurorrhaphy and neurolysis. Other operations such as neurectomy, nerve transplantation, excision of neu-

methods fail. Ligation of an aneurysm will restore function in an extremity if the aneurysmal sac has been compressing an important nerve.

In the face of extensive scarring and destruction of tissues as noted in cases of severe gunshot wounds, infection and combined injuries of nerves, tendons and bones, the normal landmarks are badly distorted and a careful dissection is frequently required to identify the proximal and distal ends of a severed nerve. Early exploration in such cases is quite often necessarily delayed. The surgeon will be wise to familiarize himself with the normal anatomy of the region he is expecting to explore and by approaching the lesion from the normal tissues he will be assisted no end in his problem. Long incisions that are made in the proper places will be useful. Several inches of nerve gap can be overcome very easily by dissecting the nerve high in the normal tissues and suturing of the nerve without tension may be assisted by anatomic shortening if this is necessary. Care should always be taken in making skin incisions about the popliteal space and wrist. Bad contractions are often detrimental to the normal function of such important joints and should be avoided whenever possible. Curved incisions are often better than straight ones.

NEURORRHAPHY

Neurorrhaphy includes excision of the proximal and distal neuromas and careful suturing of the normal ends of the nerve without tension. Many suture materials have been used with good results^{14, 18, 19} but fine black silk on an atraumatic needle is used more extensively than any other material. When anatomic shortening is necessary for anastomosis, a sling suture of radiopaque material such as tantalum wire can be used to check the union of the two ends of the nerve after the extremity has gradually been returned to its normal position. Wrapping of the nerve in fibrin film or tantalum foil after the suture has been completed is to be discouraged. Judicial splinting and early physical therapy are to be encouraged. Since the rate of growth of a nerve is estimated to be 1 to 2 mm per day, it is

obvious that the period required for functional recovery of a radial nerve injured just above the elbow will be much less than the time required for a patient to be able to perform proper work. The patient should be carefully supervised in his problems until function is assured.

NEUROLYSIS

When the continuity of the nerve is intact but the function of the nerve is impaired neurolysis is often necessary to bring about the return of normal function. The nerve can be carefully freed from the surrounding scar and the constricting bands of adhesions can be interrupted by sharp dissection. Internal neurolysis is accomplished by infiltrating the nerve with physiologic solution of sodium chloride which is of value in releasing adhesions about the nerve bundles by gradual distention and separation of the fibers within the nerve sheath. Improvement in function is often amazing after such simple operations and is not to be confused with a spontaneous recovery of the nerve without exploration.

NERVE TRANSPLANTATION

It is frequently advisable to transplant a nerve from its normal anatomic position to one which will shorten a gap in the nerve or one which will protect it from external trauma. Sometimes the radial nerve can be transplanted to a position on the mesial aspect of the humerus and valuable length gained in overcoming a large defect between the injured ends. The ulnar nerve is frequently injured in the ulnar groove at the elbow joint and tardy ulnar nerve palsy may develop years after the original trauma to the bony structures. It is advisable in most injuries of this type to transplant the nerve from its normal position behind the joint to a position under the flexor *carpi ulnaris* muscle. When the ulnar nerve is severed and it is necessary to transplant the nerve so as to bring about a good end to end anastomosis the procedure is invaluable and can be combined with anatomic shortening by flexion of the elbow joint to overcome long defects of the nerve.

BONE RESECTION

In combined injuries of bone, tendons and nerves of an extremity it is often necessary to resect a portion of bone in order to bring

the ulna were destroyed for a distance of about 3 inches (7.62 cm). By resecting 3 inches of the radius, as represented in figure 309 (lower) a good end to end anastomosis of both nerves and most of the tendons was made possible. The patient obtained a very satisfactory result. At times the humerus can be shortened during open

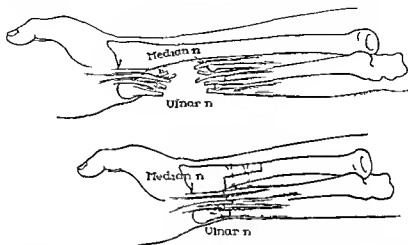


Fig 309—Upper, Severe injury to right forearm with loss of tendon, nerve and bone structures for about 3 inches (7.62 cm). Lower, Repair of nerves and tendons by shortening the radius.

reduction of a fracture so that a large gap in the damaged radial nerve is easily overcome. When the peroneal nerve is sutured at the knee, some authors advocate resection of the neck of the fibula to improve mobility of the nerve and to avoid direct trauma at the suture site.

COMPRESSION OF NERVE BY ANEURYSMS

The loss of function of a nerve due to compression by an aneurysm was shown to be a very common entity during the recent war.⁶ At times, compression alone had accounted for the disability, but frequently the missile which had injured the blood vessel also had interrupted the continuity of the nerve. Figure 310 represents compression of the sciatic nerve at the sciatic notch by an aneurysm of the gluteal artery. The nerve had not been interrupted, but the compression of the aneurysm had caused complete paralysis. At operation it was necessary to pack the sac of the aneurysm with gauze because of hemorrhage since the proximal end of the artery could not be ligated. Eight days later, the pack was removed and a portion of gluteal muscle was inserted and the sac sutured over this to safeguard against

subsequent hemorrhage. Figure 311 shows an aneurysm of the axillary artery which had caused paralysis of the median nerve by compression. It was also found that the missile had caused interruption of the musculocutaneous nerve, which was easily repaired by end-to-end anastomosis. Double ligation of the artery with removal of the sac of the aneurysm resulted in rapid return of function in the median nerve. By the end of six months, function was also noted in the distribution of the repaired musculocutaneous nerve.

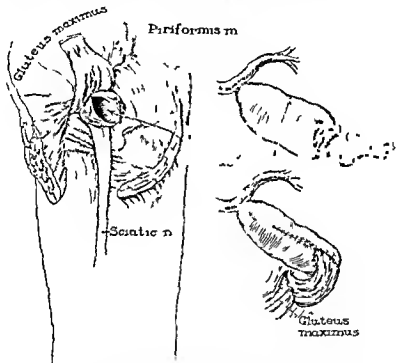


Fig. 310—Compression of sciatic nerve by aneurysm of gluteal artery

NERVE GRAFTS

Perhaps the best type of graft to undertake at the present time is an autogenous cable graft,⁴ but all efforts to bring about union of the nerve should be tried first. The facial nerve has been successfully repaired by nerve graft,⁵ but the defect is usually small and the repair in the facial canal is devoid of the external influences of the soft tissues as in other peripheral nerves.

In general, it may be stated that whenever a nerve could not be repaired by the methods usually employed to bring about end-to-end suture, the use of a nerve graft in the human race produced a poor

result^{18 19} Most of the literature pertaining to successful nerve grafts has been primarily restricted to animal experimentation^{18 19 20} and attempts on the part of many neurosurgeons to bring about clinical regeneration by homogeneous or autogenous grafts must be regarded as unsatisfactory. In time, it may be possible to change this discouraging outlook to one of optimism and it is to be hoped that the renewed investigations in surgery of the peripheral nerves during the recent world war will be of valuable assistance in this problem.

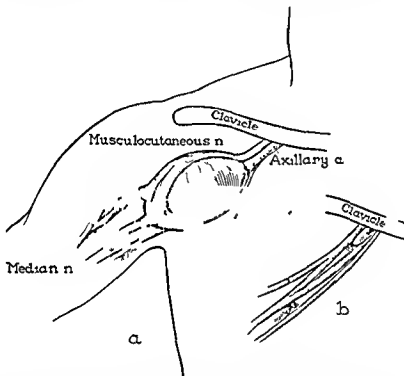


Fig 311—*a* Aneurysm of axillary artery compressing median nerve and as associated with interruption of musculocutaneous nerve *b*, appearance after resection of aneurysm and end to end suture of musculocutaneous nerve

CAUSALGIA

Pain is seldom a complication when a nerve has been completely

protect the fingers or toes from an objects and cannot stand to have anything touch them. They prefer cold compresses, such as wash cloths or even running water, and will not tolerate heat in any form.

Motions of the body, noises, mental anxieties, and so forth, always excite the severe burning pain. Incomplete lesions of the median and tibial nerves seem to be the most common sources of causalgia. This is thought to be due to the fact that these nerves carry a larger percentage of sympathetic nerve fibers. Diagnostic sympathetic nerve blocks will distinguish causalgia from other painful syndromes, and true, major causalgia is usually relieved temporarily by repeated injections of anesthetic agents into the sympathetic nerves or permanently by sympathectomy. When there has been damage to the soft parts or blood vessels, a persistent pain may exist which may be relieved by exploration of the wounded region and by releasing a major vessel from dense adhesions and scar. This pain may be regarded as minor causalgia and is not always affected by nerve block, sympathectomy or by local operation. In cases of this type it is advisable to bring about relief before a mental pain pattern or drug addiction occurs, and early intervention is advocated.²¹ In cases of long standing causalgia the skin over the affected parts will be pink and glossy and there usually will be associated wasting of the muscles, hyperhidrosis and trophic changes of the digits. The joints will stiffen and the roentgenogram of the bones may show evidence of rarefaction and osteoporosis.

METHODS OF IMPROVING FUNCTION WHEN NEUROMIAPHTY FAILS

When the function of an extremity is impaired by failure of the nerve to regenerate and other attempts at resuture or neurolysis have been unsuccessful, it is well to consider all the possible surgical procedures which could be employed to bring about the most useful extremity. Tendon transplantation for radial nerve paralysis has been exceptionally well handled. Resection of normal bone to bring about end-to-end anastomosis of the radial nerve may be associated with more dysfunction than accompanies a good tendon transplant for extension of the hand. It is my opinion that the results of this procedure are so gratifying that it should be used in all cases in which failure of nerve surgery is obvious.

There does not seem to be a very satisfactory method for correcting foot drop in cases of palsy of the peroneal nerve and tendon transplantation is not as helpful as a well made *ankle-foot*.

When a patient is required to walk over rough ground as in farming. When street and office work is required, a less cumbersome apparatus may be satisfactory.

When the median nerve has been irreparably damaged, such procedures as the "opponens interposition operation" as advised by Bunnell, are of value in assisting in the formation of a better grasping

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ANSERINA BURSTITIS, A PAINFUL CONDITION OF THE KNEE (CYSTIC HYGROMA OF HORSEMEN)

HENRY W MEYERDING AND JESSE P CHAPMAN

THE largest and most consistent bursa of the three located at the inner aspect of the knee is the one between the lower portion of the tibial collateral ligament and the tendons and insertions of the sartorius, gracilis and semitendinosus muscles. This bursa is known as

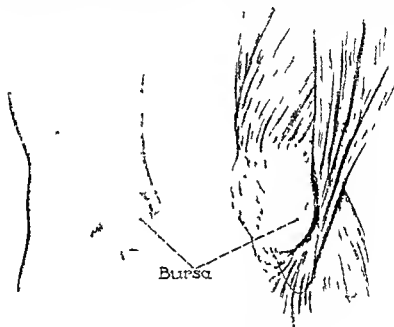


Fig 312—Left, a right leg showing a distended anserina bursa right, the relationship of a distended anserina bursa to the tendons of the sartorius, gracilis and semitendinosus muscles

the anserina bursa. It gets its name from the fan shaped insertion into the tibia of the three previously mentioned muscles which insertion sometimes is referred to as the "pes anserina" or "goose's foot" (fig 312 left). Both of these tendons are situated between the medial collateral ligament and an inferior one.

The tendons of the sartorius gracilis and semitendinosus muscles as they pass across the knee joint at first lie slightly posterior to the medial femoral condyle and then describe an arc the concavity of which is directed anteriorly to fit the contour of the medial aspect of the tibial head. The tendons then pass forward over the medial collateral ligament of the knee to insert as a fan shaped aponeurosis (pes anserina) in the proximal portion of the medial surface of the tibia. The sartorius largest and most superior muscle overlies the tendons of the gracilis and semitendinosus muscles these two latter form a second plane in which the semitendinosus muscle is slightly deeper and inferior to the gracilis muscle.

Between the tendons that constitute the pes anserina and the medial collateral ligament of the knee there is a large bursa (the bursa anserina) located on the medial aspect of the tibia near the junction of the diaphysis and proximal portion of the metaphysis. Anatomists generally ascribe two bursae to this region (1) the bursa musculi sartorii propria separating the sartorius muscle from the gracilis and semitendinosus muscles and (2) the bursa anserina separating the latter two muscles from the medial collateral ligament. Poirier dissected some 450 knees in a study of the bursae and found that in only one of six adult cadavers were there two separate bursae. In the remaining 83 per cent of such cadavers there was only the one large bursa. One of us (Meyerding⁴) referred to the anserina bursa in a previous publication writing that this bursa lies between the conjoined tendon of the gracilis and the semitendinosus muscles and the tibia and that it may connect with the bursa musculi sartorii propria between the tendon of the sartorius muscle and the conjoined tendon of the gracilis and semitendinosus muscles. A case of anserina bursitis was presented on another occasion⁵ in which the patient had been operated on and the bursa had been found to be filled with osteo cartilaginous bodies.

The form of the anserina bursa is roughly that of a right triangle with one side of the right angle parallel to and some 2 cm posterior to the tibial crest and with the other side of this right triangle lying in a horizontal plane roughly parallel to the superior border of the sartorius tendon. The dimensions of this bursa are variable but the

the base of the wedge directed posteromedially (fig 312 right)

In spite of the size and constancy of this bursa as well as its location in a region susceptible to trauma very little has appeared in the medical literature concerning conditions which may affect this bursa. Le Fort and Albert reported five cases of anserina bursitis among cavalrymen who received constant trauma to this region they judged

it to be a clinical entity which they called "cystic hygroma of cavalrymen." Le Bourgo in 1930 reported three cases of anserina bursitis, in one, tuberculosis of the anserina bursa had afflicted a soldier twenty-one years old, in the other two cases nonspecific inflammation had occurred among men in their late thirties. Moschcowitz in 1937 reported some "twenty to twenty five" cases, and called attention to the fact that anserina bursitis could be a cause of pain which might be confused with chronic arthritis. He described the condition as of common occurrence among obese women who gave a typical history of the production of pain in the inner portion of their knees on walking up and down stairs. His patients obtained their greatest relief by means of loss of weight. Zadek in 1942 reported a single case in which the condition afflicted a Negro, fifty years of age, who had had a swelling of the right knee for one and a half years that had been associated with local pain and a burning sensation.

PRESENT SERIES

In our series of fourteen cases, the consistent finding was swelling on the lower medial aspect of the knee. In general, this swelling was associated with a dull aching or burning type of pain, which was made worse by motion and was relieved by heat or rest. In all but one of our cases the condition occurred in males, the majority of whom had been employed at heavy labor. The average age was forty six years, with a range from thirteen to sixty seven years. The average length

TABLE 1

ANSERINA BURSTITIS DETAILS IN FIVE CASES NOT REPORTED IN TEXT*

Case	Age	Duration Symptoms months	Location (Knee)	Pain	Stiffness Jelling	Treatment	Result
10	46	24	Left	Yes	No	Conservative	Good
11	49	84	Right	Yes	No	Surgical	Recurrence, 15 years
12	67	12	Right	No	No	Surgical	Good
13	54	3	Left	Yes	Yes	Röntgen ray	?
14	45	?	Left	No	No	Surgical	?

* The other nine cases required to bring the total to fourteen are reported in detail in the text.

of duration of symptoms before a patient reported for treatment was nineteen months, with a variation from one month to seven years. Our only female patient was forty two years of age, she had been employed as a hotel chambermaid, which necessitated working on her knees.

Of our series of fourteen patients, six did not have surgical treatment. Of these six, two were advised to accept conservative treat-

ment because of extensive hypertrophic arthritis of the knee joint. One received conservative physical therapy because of the brief duration of symptoms (four weeks). Three patients were unable to remain at the Clinic for surgical treatment.

Surgical excision is the treatment of choice and we advised this for ten of our patients. Eight of the patients remained at the Clinic for such treatment. We shall report nine cases in the text, the remaining five cases are summarized in table 1.

REPORT OF CASES

CASE 1—A farmer forty four years of age was admitted to the Clinic complaining of swelling of the left knee of two years duration. He had been seen about sixteen years prior to this admission and at that time a diagnosis of hypertrophic arthritis had been made and a loose body had been removed from the posterior portion of the left knee joint. The patient said that about a week prior to his admission the second time he had worked rather strenuously pulling weeds after which the inner aspect of the left knee had become considerably swollen and painful but that after rest and the application of hot fomentations the swelling had subsided temporarily.

The physical examination revealed a cystic mass below and medial to the patella of the left knee. The mass was not tender. A slight area of circumferential inflammation about the mass was noted. A roentgenogram of the left knee revealed marked osteo-arthritis with narrowing of the joint space. Many loose osteocartilaginous bodies were noted in the surrounding tissues.

At operation on June 14, 1935 a large anserina bursal sac 6 by 6 by 4 cm. was removed from the inner aspect of the left knee. This sac apparently originated from the fascial plane just below the tibial margin. The sac was thick walled and was filled with a clear yellowish fluid of semimucogelatinous and serous character. At the base of the sac there was a deposit of xanthomatous tissue. The specific gravity of the fluid was 1.023. The report of the pathologic examination was "bursitis with thickened fibrous walls." The patient's postoperative course was entirely uneventful. More than a year later the patient reported that he was able to walk as well as anyone and that he was very well satisfied with the result.

CASE 3—A farmer, thirty years of age, was seen at the Clinic in February, 1935. A mass about the size of an egg was noted on the medial aspect of the head of the left tibia. Anteroposterior roentgenograms of the left knee revealed a soft-tissue shadow (anserina bursa) about $1\frac{3}{4}$ inches (4.5 cm) in diameter on the medial aspect of the left knee joint, with a small calcified zone in the outer aspect. Lateral roentgenograms of the knee joint revealed the mass projecting posteriorly.

Operation was advised and accepted. The anserina bursa was excised from its position between the semitendinosus and gracilis tendons. The bursa contained a typical, apple-jelly like substance. The patient was seen seven months



Fig. 313—Left knee of the patient in case 3 showing a soft tissue shadow on the medial aspect of the upper part of the left tibia, with small zone of calcification.

later, at which time he had an entirely asymptomatic knee. The operative wound was healed (fig. 313).

CASE 4—A farmer, forty years of age, was seen at the Clinic complaining of locking of the left knee of two years duration. He said that the episodes of locking occurred as often as every week, but less often during the summer, and that they were associated with only moderate pain and occasionally with slight swelling. He further said that about five months prior to his admission he had first noticed a minute swelling (a half inch or 1.3 cm) on the inner aspect of the lower portion of the left knee. This swelling had progressively increased in size until it became about 2 inches (5 cm) in diameter.

Physical examination disclosed a well-developed well nourished man of 190 pounds (86.2 kg). A smooth hard, round mass 2 inches (5 cm) in diameter was seen lying on the lower medial aspect of the left knee. Apparently it was attached to the underlying tissues. This mass was not tender. There was no abnormal motion in the knee joint, but normal extension of the knee was limited by 10 degrees. There was no periarthritic swelling or thickening. A loose osteo-cartilaginous body was present above the patella. The roentgenograms disclosed a portion of osteochondromatosis in the anserina bursa of the left knee (fig 314 a).

returned a year later with multiple loose bodies in the opposite (right) knee

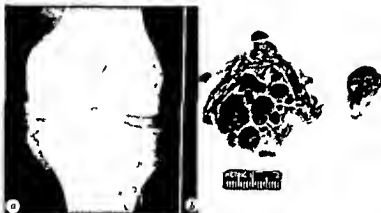


Fig 314—*a* Left knee in case 4 showing osteochondromatosis in the anserina bursa. *b* gross specimen removed at operation in case 4 showing loose osteo-cartilaginous bodies in the anserina bursa. To the right in the photograph is shown the loose body removed from the suprapatellar pouch.

These were removed. In spite of these procedures soreness persisted in both knees when the patient walked more than a quarter mile.

CASE 5—A boilermaker, forty nine years of age, was admitted with a history

movable. A roentgenogram of the left knee revealed a soft tissue swelling over the medial tibial condyle without bony deformity.

At operation a longitudinal incision was employed. Dissection was carried down the inner aspect of the knee to the bursa. The sac was readily excised. Closure of the resulting defect was made by pulling over the tendons of the sartorius, gracilis and semitendinosus muscles anteriorly. The patient made a satisfactory recovery while he was under our observation.

CASE 6—A boy thirteen years of age had first noticed a swelling medially below the left knee four weeks prior to his admission at the Clinic. There was no history of injury. The swelling had recurred every three or four days after the onset and had lasted about twenty-four to forty-eight hours after which it completely subsided. When the swelling was at its height the patient was unable to extend his knee completely because of the pain produced. He said that the pain was great.

The boy with the left anserina bursitis was made and physical therapy was advised.

CASE 7—A man sixty-seven years of age came to the Clinic complaining chiefly of pain and swelling over the medial aspect of the right knee of two years' duration. Two years prior to his admission the patient had first noticed nocturnal pains in the right knee of sufficient intensity to awaken him from sleep. Similar diurnal pain also occurred after extensive use of his legs. About the same time he had noticed a small soft swelling on the medial aspect of the right knee; this swelling was gradually increasing in size. The pain could be relieved temporarily by the application of heat but was unaffected by weather or rest. There was no history of instability of the knee joint or of locking. The right femur had been fractured some thirty-nine years prior to the patient's admission. This had resulted in $1\frac{1}{4}$ inches (3.2 cm.) of shortening.

CASE 8—A man fifty-five years of age complained incidentally that motion

At physical examination a snapping sensation was imparted as the gracilis and sartorius tendons slipped over a small distention of the underlying anserina bursa. Results of roentgenograms were negative. The patient was advised to undergo excision but decided to defer it.

CASE 9—A laborer aged twenty-three years gave a history of pain in the ache in the medial side of the right knee after he had played an unusually strenuous

ous game of tennis Swelling of the knee and a dull aching pain had persisted more or less constantly from that time to the time we saw him. There had been no locking, but increased stiffness and pain on prolonged use of the knee had been noticed The application of heat provided relief from symptoms

The physical examination revealed a slight swelling and fluctuation over the medial aspect of the head of the right tibia There was no tenderness, but marked atrophy of the right quadriceps femoris muscle was present Roentgenograms disclosed nothing abnormal

A large anserina bursa filled with a thick, glairy, mucilaginous fluid, and two smaller cysts of the medial semilunar cartilage were excised The postoperative course was uneventful and the patient remained asymptomatic for six years after the operation At the end of six years however, he was seen elsewhere because of a recurrence of the condition including pain and tenderness over the site of insertion of the medial collateral ligament into the tibia The diagnosis made elsewhere was bursitis Treatment by the injection of procaine hydrochloride and multiple puncture was carried out with improvement

SUMMARY

A brief review of the anatomic aspects, symptoms and literature of anserina bursitis has been presented, and fourteen cases of our own have been mentioned Nine of the fourteen cases have been reported herein The possibility of an affection of the anserina bursa should be considered in the presence of chronic, low grade swellings of the inner aspect of the knee with dull localized pain and other symptoms which may be confused with those of chronic arthritis When the condition is acute or subacute, treatment should be conservative, it should consist primarily of rest reduction of weight and physiotherapeutic measures or aspiration of the contents of the bursa Surgical removal is indicated in cases of recurrence osteochondromatosis, or in cases of long duration of the condition

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TREATMENT OF CARCINOMA OF THE LIPS

JOHN B. ENICH

ACCESSIBILITY and visibility are two factors which contribute immeasurably to the successful management of carcinoma of the lips. Not only is the prognosis for an individual patient in the early stages of the disease greatly influenced by the accessibility of the lesion, but also the time after the onset of the disease and particularly if treated before metastatic lesions have developed in the cervical nodes. Unsatisfactory results in the care of these lesions usually can be attributed to one or more of the following causes: (1) ignorance, unconcern or fear of operative procedures on the part of the patient, (2) failure of the clinician to recognize malignant lesions of the lips, with the result that much valuable time is lost before proper treatment can be instituted, (3) the application of caustic drugs, particularly silver nitrate which may increase seriously the activity of a relatively slow growing neoplasm, (4) insufficient treatment or unsuitable forms of treatment, and (5) neglect of the regional lymphatics.

The lips are a rather common site for the development of carcinoma. Of all the malignant tumors of the entire body treated at the Mayo Clinic during 1945, 23 per cent involved the lips. Carcinoma in this location is definitely a disease of men, since we have found that only a trifle more than 1 per cent of the patients who have this disease are women. More peculiar, however, is the fact that about 98 per cent of these lesions are on the lower lip only.

In many cases of carcinoma of the lips, no cause whatsoever can be found for the development of the growth. Long continued exposure to the sun and wind and chronic irritation from tobacco seem to be the most common etiologic factors. Leukoplakia, chronic inflammatory ulcers, chronic scaling lesions, chronic fissures or cheilitis often precede the development of epitheliomas on the lips. In some instances trauma and actinodermatitis are contributing causes. Although the irritative factors just listed never produce malignant lesions in some individuals, it is certain that they do contribute to the development of such lesions in many others. Consequently, in any discussion on the preventive treatment of carcinoma of the lips these etiologic conditions should receive careful consideration.

Malignant tumors which affect the vermillion portion of the lips are limited for the most part to squamous cell epitheliomas. Practically all such lesions in this location arise primarily in the mucous mem-

ous game of tennis. Swelling of the knee and a dull, aching pain had persisted more or less constantly from that time to the time we saw him. There had been no locking but increased stiffness and pain on prolonged use of the knee had

closed nothing abnormal.

A large anserina bursa filled with a thick glairy mucilaginous fluid, and two smaller cysts of the medial semilunar cartilage were excised. The postoperative course was uneventful and the patient remained asymptomatic for six years after the operation. At the end of six years however he was seen elsewhere because of a recurrence of the condition including pain and tenderness over the site of insertion of the medial collateral ligament into the tibia. The diagnosis made elsewhere was bursitis. Treatment by the injection of procaine hydrochloride and multiple puncture was carried out with improvement.

SUMMARY

A brief review of the anatomic aspects, symptoms and literature of anserina bursitis has been presented and fourteen cases of our own have been mentioned. Nine of the fourteen cases have been reported herein. The possibility of an affection of the anserina bursa should be considered in the presence of chronic low grade swellings of the inner aspect of the knee with dull localized pain and other symptoms which may be confused with those of chronic arthritis. When the condition is acute or subacute treatment should be conservative; it should consist primarily of rest, reduction of weight and physiotherapeutic measures or aspiration of the contents of the bursa. Surgical removal is indicated in cases of recurrence, osteochondromatosis or in cases of long duration of the condition.

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plastic closure of the resultant defect is possible, thus permitting prompt reconstruction of the lip with a satisfactory cosmetic result. Second, and of more importance than the first, is the fact that surgical removal of the local lesion permits a detailed histologic examination of the entire growth. At the Clinic, when an epithelioma of the lip is excised, it is sent at once to the pathologist who freezes the tissue and immediately prepares sections for microscopic study, the grade of activity of the tumor is determined and the edges are checked to make certain that the lesion has been completely removed and that a border of normal tissue surrounds it. The preparation and examination of frozen sections of tissue by a competent pathologist requires but a few minutes and the information derived from such histologic study is invaluable to the surgeon. After an epithelioma of the lip has been excised, we always wait a few minutes for the pathologist's report before proceeding with the closure of the wound.

ure Not until the diagnosis is certain should radical removal of a questionable growth be attempted. The excision of bits of tissue for biopsy does no harm providing that the necessary treatment is instituted within a reasonable length of time thereafter.

TREATMENT OF PRECANCEROUS LESIONS ON THE LIPS

It is reasonable to assume that the removal of lesions which are nonmalignant but which are likely to lead to the development of an actual carcinoma will contribute greatly to the control of malignant

Surgical removal and microscopic study is the treatment of choice rather than irradiation. As shown in figure 315 the exposed part of the mucous membrane of the lip is completely excised under local anesthesia and the mucous membrane at the edge of the wound is under-

two or three months

The mucous membrane removed in this fashion always is examined how many of these precancerous
quant change, that is, are grade 1

ly enthusiastic about this form of treatment for precancerous lesions of the lips in view of the fact that several hundred operations of this type have been performed without

brane, although the vermilion border occasionally is invaded secondarily by squamous cell or basal cell epitheliomas which start in the surface. The growth of the lip spread and involve the entire lip, those on the lower lip may infiltrate the tissues of the cheek or chin, become attached to the periosteum of the mandible. The mandibular margins, some are deeply ulcerated and inflamed whereas others are large fungating masses. Clinically, little difficulty is encountered in the diagnosis of epitheliomas on the lips, although some of them, particularly the more

does not heal in three or four weeks, a specimen should be removed

vanced stage

All carcinomas at the Clinic are examined microscopically and are graded from 1 to 4 (Broders' classification), grade 1 being the least malignant and grade 4 the most malignant. In studying a large series of cases at the Clinic of primary and untreated epithelioma of the lower lip, Figg found that in 38.77 per cent the epitheliomas were grade 1, in 52.17 per cent were grade 2, in 8.51 per cent were grade 3 and in 0.54 per cent were grade 4. Since it is generally accepted that malignant neoplasms of low grade are radioresistant, we believe that it is extremely important to determine the grade of activity of all epitheliomas on the lips, particularly when dealing with the treatment of the regional lymphatics. This phase of the subject will be discussed later. Also relative to the histologic grading of epitheliomas of the lips and of great clinical importance is the fact that active inflammation, whether due to infection or to the application of caustic agents, such as silver nitrate, can definitely increase the activity of a malignant lesion, thereby inviting early metastasis or perhaps changing a relatively slow-growing and inactive carcinoma to one of a much more serious nature.

The treatment of epitheliomas of the lips should be thorough, which at times necessitates extreme therapeutic measures to effect a cure. In general, we believe that wide surgical excision of the primary lesion is the treatment of choice, having two distinct advantages. First, the local lesion is rapidly removed, in most instances, an immediate

brane offers a better cosmetic result than does the excision of only a portion of the mucosa.

Many patients with a frank epithelioma on the lower lip also may have thickened patches of leukoplakia or keratoses elsewhere on the lip. In these cases excision of the malignant lesion can be combined with removal of the exposed mucous membrane as just described. Such treatment not only removes the epithelioma but also prevents the development of other epitheliomas on the lip.

TREATMENT OF CARCINOMA OF THE UPPER LIP

In many ways, more difficulties are encountered in the surgical removal of malignant tumors of the upper lip than of the lower lip. Consequently it is fortunate that the upper lip is an uncommon loca-

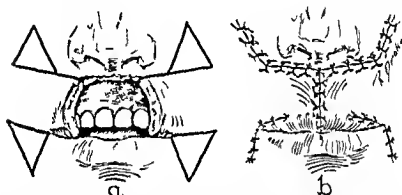


Fig 316—Method of closure of defect of middle third of upper lip following removal of a carcinoma. After the incisions indicated in *a* have been made and after the four triangular portions of the full thickness of the cheeks have been removed the two lateral flaps of tissue can be advanced and sutured in the median line (*b*).

tion for epitheliomas. For very small carcinomas on the upper lip an acceptable closure can be obtained by the surgical removal of the lesion in such a fashion as to form an inverted V shaped wound, the margins of which are sutured together. However, for larger epitheliomas this procedure, even in conjunction with plastic operations at the angles of the mouth, is most unsatisfactory because of the fixation of the soft tissues at the base of the nose.

After excision of carcinomas in the central portion of the upper lip repair can be accomplished by moving flaps of the full thickness of the cheeks across to the median line (fig 316). This is a rapid method of closure and one to be recommended since it can be completed in a single stage. If the loss of tissue is confined to the middle third of the

a single patient ever having an epithelioma on the lip subsequently. It is interesting to find that for unknown reasons, precancerous lesions are extremely rare on the upper lip, consequently, the operation just described for excision of the exposed mucous membrane is limited largely to the lower lip. Not infrequently, a precancerous lesion involves only a small portion of the lip, under these circumstances it

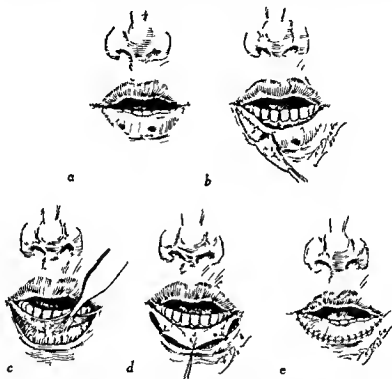


Fig 315—Method of excising entire exposed part of mucous membrane of the lower lip for precancerous lesions *a* Mucous membrane to be removed is shown by dotted line *b* Mucous membrane being excised *c* Mucous membrane at edge of wound is undermined *d* Mucous membrane at edge of wound being sutured to cutaneous edge *e* Wound completely sutured

generally seems preferable to excise all of the exposed mucous membrane of the lip rather than just an ellipse of tissue around the lesion itself. We have seen many patients who have had a precancerous lesion removed on one side of the lip and who later had a similar lesion on the opposite side. If all of the exposed mucous membrane had been removed at the initial operation this difficulty would have been obviated. Then, too, excision of all the exposed mucous mem-

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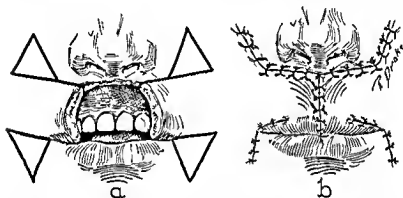


Fig. 316—Method of closure of defect of middle third of upper lip following removal of a carcinoma. After the incisions indicated in *a* have been made and after the four triangular portions of the full thickness of the cheeks have been removed the two lateral flaps of tissue can be advanced and sutured in the median line (*b*).

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than does an Estlander

sists in the transference of a wedge of tissue from the normal lower lip to the defect of the opposite lip. This operation is a particularly effective method of closing a defect due to removal of a carcinoma of the outer portion of the upper lip. The triangular flap from the lower lip with a pedicle containing the inferior labial artery is rotated and sutured into the defect of the upper lip. When healing is complete (a matter of three weeks) the pedicle is cut across and the vermilion borders of the upper and lower lips are readjusted.

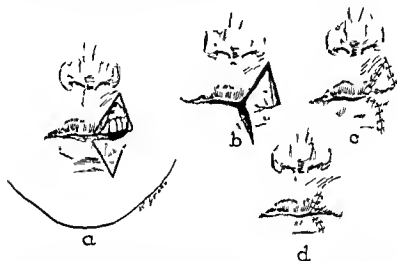


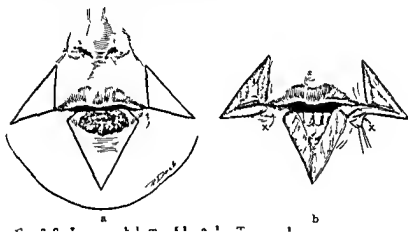
Fig. 317—An Estlander type of operation for closing a defect of the outer third of the upper lip following the removal of a carcinoma. The lesion is removed so as to leave an inverted V shaped defect. A triangular wedge of tissue from the lower lip with a pedicle containing the inferior labial artery is rotated and sutured into the defect. After three weeks the pedicle is cut across and the vermilion border of each lip is readjusted as shown in lower drawing.

When an epithelioma on the upper lip is so large that its removal results in loss of the greater part of the lip it is preferable to leave the wound open and reconstruct the part by means of a forehead flap or a clavicular or cervical tube flap of skin. These flaps must be elevated and delayed in stages to insure their blood supply before they can be transferred to the defect. Consequently their preparation requires several weeks. A forehead flap offers skin of good color and texture and can be transferred to the defect quicker than a tube flap. Only for bald headed individuals or for those who prefer to have no

scarring on the forehead is a clavicular or cervical tube flap of skin used to reconstruct an upper lip. The problem of pedicle skin flaps to repair an upper lip will not be considered further here since it is not directly concerned with the treatment of carcinoma of the upper lip.

TREATMENT OF CARCINOMA OF THE LOWER LIP

In removal of epitheliomas which do not involve more than a third of the lower lip a V-shaped incision is used, after excision of the lesion the margins of the tissue are sutured together. The subcutaneous tissues, muscle and mucous membrane are approximated with catgut sutures and the edges of the skin with interrupted fine silk stitches. When properly executed, this operation leaves an excellent cosmetic result, since the small amount of tissue removed does not change appreciably the width of the oral fissure.



portions of skin also sutured at angles of mouth (x)

epithelioma - high lip - V -

results, the width of which must be increased by a plastic operation on the upper lip and cheek at both angles of the mouth. Actually, per- this low

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that the lateral incisions required

in the reconstruction of the lower lip also have increased the width of the upper lip. This necessitates a reduction of the upper lip to its normal horizontal dimensions by removing a triangular portion of

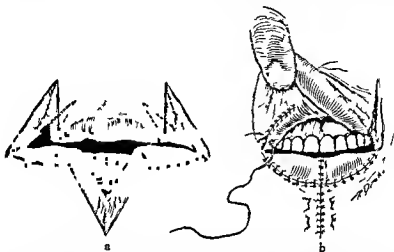


Fig. 319—V shaped defect (a) of lower lip is sutured together in median line (b). Mucosal and cutaneous edges of lateral incisions are sutured together (a and b) to form vermilion border for new lower lip. The dotted triangular areas (a) of mucous membrane on either side of upper lip when excised and sutured tend to produce a more normal contour of new angles of the mouth.

tissue at each angle of the mouth. The end result of this plastic procedure is most satisfactory both from a cosmetic and a functional standpoint even in cases in which practically the entire lower lip has been removed. Some surgeons prefer not to reject the triangular pieces



Fig. 320—Epithelioma of one side of lower lip. Reconstruction of lower lip here requires plastic operation at only one angle of mouth as outlined in drawing.

of cheek tissue at each angle of the mouth but to cut them as pedicle flaps and to turn them down for reconstruction of the lower lip. However, my colleagues and I believe that better results are obtained when these triangular pieces of tissue are discarded.

When a large epithelioma is confined to one side of the lip, a satisfactory reconstruction of the lip can be accomplished often by doing a plastic operation at only one angle (on the same side as the lesion) (fig 320)

Whenever an epithelioma of the lower lip invades the tissues of the cheek its removal cannot be followed by an immediate plastic closure. Furthermore, if a large carcinoma (fig 321) of the lower lip has become attached to the periosteum of the mandible or actually invaded the bone, it should be removed by surgical diathermy (electrocoagu-

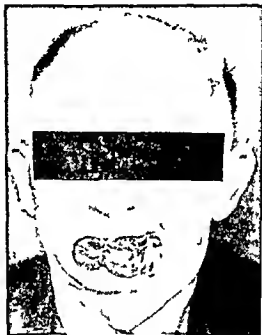


Fig 321—Very extensive epithelioma of entire lower lip and chin with invasion of periosteum of mandible. This required cautery excision of lesion and electrocoagulation of involved periosteum.

lation) The entire growth is excised by the cutting cautery while the underlying periosteum and bone to which the growth was attached is thoroughly electrocoagulated. This form of treatment results in a sequestrum of bone which gradually separates and can be removed in two or three months. A radical procedure of this type, we believe is necessary to cure the carcinoma but it unavoidably produces a conspicuous facial defect. Reconstruction of the lower lip and chin can be carried out eventually by plastic measures after it is fairly certain that growth will not recur. This means a delay of twelve months after

operation Reconstruction of the entire lower lip and chin demands a large tube flap of skin such as a chest or subaxillary tube. The best cosmetic result can be obtained by the use of the skin at the upper end (near the clavicle) of a chest tube flap; the color of the skin in this region resembles more closely that of the face than does the skin lower down on the trunk of the body.

At the Clinic as far as the local primary lesion is concerned the use of radon seeds, radium plaques or external irradiation is confined generally to large epitheliomas grade 4 of the lips, also to carcinomas of very elderly individuals or to malignant lesions on the lips of patients for whom the surgical risks are extremely great.

TREATMENT OF CERVICAL LYMPH NODES

Of the utmost importance in any consideration of epithelioma of the lips are the regional lymph nodes. Owing to the rich supply of lymph vessels about the lips, cervical metastasis can occur early in the course of the disease even though the primary lesion is rather small. In all individuals lymph channels are present which drain into the nodes of the submental and submaxillary triangles. Usually extensions to the neck from a primary lesion on the lip involve first the submental or submaxillary nodes and are limited to the side corresponding to that of the primary tumor. However, if the original growth is traumatized or inadequately treated, metastatic growths may develop in the opposite side of the neck. It is generally known that in some individuals a few lymph vessels from the lower lip may drain into the deep cervical nodes on the same or opposite side of the neck and sometimes may even enter the mental foramen of the mandible. Consequently it is possible although unusual for a metastatic growth to develop in a deep cervical node without any evidence of metastasis to the submental or submaxillary nodes in some cases of epithelioma on the lower lip. Involvement of a mental node is extremely rare and practically never occurs unless the primary lesion is recurring due to inadequate treatment.

Since metastasis to the regional lymph nodes is likely to occur, the therapeutic management of patients who have carcinoma of the lips should include not only removal of the primary lesion but treatment of the nodes in the neck as well. We believe that the most effective method of preventing cervical metastasis is to block off the lymph channels by surgical removal of the cervical nodes. Because the submental and submaxillary nodes are most likely to become involved, we recommend that every dissection of cervical nodes include dissection of submental and submaxillary nodes and also the nodes near the upper part of the jugular vein. If on microscopic examination by the frozen section method one or more of these nodes is found to be involved by a metastatic lesion, an immediate block dissection of the

deep cervical lymph nodes is carried out on the involved side. I would like to repeat that at the Clinic bilateral dissection of the submental and submaxillary nodes and the nodes along the upper part of the jugular vein is carried out as a routine procedure whenever any cervical nodes are removed. A block dissection of the deep nodes is resorted to only when one or more nodes in the submental submaxillary or upper part of the jugular regions are found to be involved. When block dissection of the deep nodes is undertaken removal of the sternomastoid muscle is advocated only when in lesions of a high grade of malignancy or when there is extensive cervical involvement by the malignant process.

A dissection of the cervical nodes for carcinoma of the lips then is carried out as a prophylactic measure to prevent metastasis as well as a curative form of therapy to remove cervical nodes already involved by the malignant process. Just which patients should be treated by dissection of the cervical nodes is determined by many factors. At the Clinic the decision rests largely on the grade of activity of the primary lesion. We have found that squamous cell epitheliomas of grade 1 practically never produce metastasis to the cervical nodes unless they are badly infected or inflamed. Consequently patients who have epitheliomas grade 1 without any evidence of cervical extension are not subjected to dissection of the cervical nodes. However as previously stated an inflammatory reaction due to infection or caustic agents can augment the activity of an epithelioma. If a primary lesion of grade 1 on the lip is badly inflamed it then may be justifiable to consider removal of the regional lymphatics.

Squamous cell epitheliomas grades 2 and 3 on the lips are so likely to produce cervical metastasis that dissection of these nodes in the neck is a routine procedure at the Clinic in all such cases whether or not there is any evidence of cervical extensions. Irrespective of the size of a primary lesion of grade 2 or 3 a gland dissection is to be recommended and the most satisfactory end results are to be anticipated in those cases in which no involvement of the nodes is demonstrable at the time of their removal.

A dissection of the cervical nodes is hardly justifiable if the primary lesion is graded 4. Under these circumstances much more can be accomplished by external irradiation to the neck than by dissection of the cervical nodes. As a matter of fact many lesions of grade 4 on the lips can be completely cured by irradiation if they have not produced generalized metastasis.

It is evident from this discussion that at the Clinic dissection of the cervical glands is not carried out in about 40 per cent of cases of carcinoma of the lip because the primary lesion is either grade 1 or grade 4. In practically all of the other 60 per cent of cases in which the lesions consist of epitheliomas graded 2 or 3 removal of the cervical nodes is recommended.

Dissection of the cervical nodes is undesirable for patients of advanced age, in poor general physical condition or with too extensive involvement of the nodes in the neck. Under these circumstances, irradiation may be considered. It is true, of course, that metastasis is less likely to develop in elderly individuals and, consequently, we usually do not advocate the removal of cervical nodes as a prophylactic measure in patients beyond 70 years of age. When involvement of the cervical nodes is so extensive as to contraindicate dissection of the cervical nodes, irradiation is recommended as a palliative rather than a curative measure.

If a solitary metastatic node is found in the neck of a patient too old or too sick for a dissection of nodes the insertion of radon seeds into the node has proved highly desirable. Usually, seeds worth 1 millicurie each are inserted at a distance of 1 cm. apart. It is not unusual for the node permanently and completely to disappear after such therapy.

dissection of cervical nodes, it probably is worth while to recommend a course of external irradiation subsequently.

As previously stated, metastasis to the mental nodes is extremely rare. However, the seriousness of this complication cannot be stressed too strongly because the malignant process seldom is confined to the nodes alone, on the contrary, carcinomatous cells are usually found to invade the mental foramen and to extend back along the mandibular canal. In cases such as this not only should the node be removed but the tissues in the mental foramen and back in the mandibular canal for a distance of 2 or 3 cm. should be thoroughly electrocoagulated. Such treatment results in a sequestrum of bone, but this seems to be the most certain method of curing the condition. It is well to add, however, that in spite of any form of treatment, recurrences are common when the mandibular canal is invaded by a malignant process.

In conclusion, I would like to state that it has not been my intention to introduce a statistical analysis of cases of carcinoma of the lips.

treatment of the disease is carried out judiciously and in the early stages of the disease.

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of
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MASSACHUSETTS GENERAL HOSPITAL
NUMBER

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THE SURGICAL CLINICS of NORTH AMERICA

MASSACHUSETTS GENERAL HOSPITAL NUMBER

FOREWORD

IN this volume, the first of the Surgical Clinics of North America from the Massachusetts General Hospital in many years, we have been able to select only a few subjects from a wealth of material offered by the Surgical Department. However, it has seemed desirable to present to the reader, as well as possible, a cross section of the activities of the Department, in order to indicate the manner in which surgery is practiced in the institution today.

Thus, there are articles from the General Surgical Service, from clinics that are staffed by members of it as well as by representatives from many other departments, and from special surgical services. These special services include anesthesia, dental surgery, and others that have been split off from general surgery in the following chronological order—orthopedic surgery, urology, neurosurgery and gynecology.

Consequently, there are contributions from each of the services and clinics. Different types of papers have been selected to present the various interests of the department. Thus, a number of articles include case reports, either typical of the group seen in the hospital, or of great interest because of their rarity. In several instances original surgical techniques are presented that have not been published heretofore. Our experience with a few of the newly established surgical procedures is described, and in other instances the progress in the field is completed. Finally, the importance of the hospital to the community is emphasized.

We hope, because of the variety of subjects presented, that this symposium will be of interest and value to all.

ARTHUR W. ALLEN, M.D.

CARCINOMA OF THE LARGE INTESTINE

ARTHUR W. ALLEN, M.D., F.A.C.S.*

THE following case reports are presented to illustrate the usual procedures found to be satisfactory in the management of malignant lesions of the bowel. As will be seen, our experience leads us to believe that resection and primary anastomosis is the method of choice. This is the natural outcome of many years of the practice of this general principle in our clinic. The rare use of the exteriorization or Mikulicz type of operation has given us inadequate knowledge of this method of attack, accounting for the accentuation of the primary anastomosis technic. We do not wish to convey the idea that we feel that exteriorizations, particularly of the obstructive type of resection at one time advocated by Rankin,¹ are bad practice. We are aware of the fact that in many hands these operations give satisfactory results. There is a growing tendency towards primary suture of the bowel that has come about through the improvements in preparation of the patient, better surgical technic and chemotherapeutic aids.

We have felt that the morbidity could be reduced by primary suture and that the mortality rates could be kept as low as those reported by the advocates of the Mikulicz principle. In our earlier experience, we believed that aseptic anastomosis was important.² Now with a better bowel preparation and other measures, we can obtain completely satisfactory primary anastomosis by the so-called open technic. Also, we formerly practiced more frequent proximal decompression often before resection, otherwise as a complementary procedure. Preliminary cecostomy is now done only in the presence of acute and complete obstruction of the left colon and complementary cecostomy is rarely done. The Miller Abbott tube is used as an added precaution in some cases.

Preliminary transverse colostomy is used only in large obstructing inflammatory lesions of the sigmoid. This procedure is mandatory in diverticulitis with inflammatory extension and by this means one can count on the resolution of the acute process even in the presence of frank abscess. Since carcinoma and diverticulitis may occur in the same region, one must consider an earlier resection in some cases. If

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process. If cancer is obvious or strongly suspected, the resection should be undertaken not later than the fourth week after transverse colostomy. If it seems reasonably certain that diverticulitis is the sole causative factor, a better procedure can be accomplished after three to six months of complete decompression. Although such practice requires three operations, the difficulties attending these are far less than can be expected by any other method at our disposal.

CASE I. CARCINOMA OF THE CECUM

This 56 year old nulliparous woman (M G II No 507289) was referred from Prince Edward Island with a diagnosis of regional enteritis. Her story was that of right lower quadrant tenderness and soreness of variable intensity



Fig 322.—Barium studies in Case I reveal a constant filling defect in the region of the ileocecal valve, which appears to extend two-thirds of the way around the lumen of the bowel producing a narrow channel in the region of the lower ascending colon. The mucosa is destroyed in the narrowed area over a distance of approximately 7 cm.

over a five to six months interval. She had lost 25 pounds in weight, and there had been a gradual increase in fatigability. She had no obstructive symptoms. Her appetite had remained good and her bowel habits unchanged. She had noted no unusual stools. Her past history was noncontributory except for the fact that she had had an appendectomy thirty years previously. She had worked hard, taking care of all members of the family.

On physical examination the patient appeared undernourished and had a rather sallow complexion. A right paramedian scar was present in the lower abdomen and there was definite tenderness lateral to this scar. Under this area a soft mass could be felt which seemed to move with respiration. She had long saphenous varicosities.

The patient remained in the hospital for ten days of study and preparation for surgery. Her hemoglobin was found to be 11.3 gm. and serum protein 7.3 gm. per 100 cc. X-ray studies following barium enema are shown in Figure 322. She was given 2 gm. of sulfathaladine four times a day beginning on the day following admission and this was continued until the time of operation. In addition she was given vitamins C and B complex, and ferrous sulfate. She obtained only a fair effect from her sulfathaladine and on two occasions milk of magnesia was given. On the day before operation a Miller Abbott tube was inserted and this was readily advanced into the small bowel with the aid of 2 cc. of mercury in the balloon.

Operation—Under spinal anesthesia, a long paramedian incision was made. Adhesions to the old appendix wound were freed. The tumor mass in the cecum was large and bulky but not fixed. There was no free fluid or evidence of extension into the liver or surrounding peritoneum. There were however enlarged lymph nodes running up along the ileocolic and right colic vessels. The lateral peritoneum was freed. The ovarian vessels were not sacrificed. The ureter and duodenum were identified. The right colic and ileocolic vessels were divided at their junction with the superior mesenteric. The transverse colon was divided within the midcolic blood supply area. The ileum was transected 30 cm. proximal to the ileocecal valve in an oblique fashion. End to end anastomosis with an outer layer of interrupted No. 30 cotton and inner layer of fine running chromic catgut was accomplished. The edges of the cut mesenteries were approximated by means of a running catgut suture. The wound was closed with catgut to the peritoneum and interrupted cotton to the fascia. Skin and fat closure was delayed forty-eight hours. The anus was carefully dilated to the width of three fingers.

The patient received one transfusion before, one during and one following operation. She was given 5 gm. of sulfadiazine intravenously for two days and then $2\frac{1}{4}$ gm. daily for two days. Forty-eight hours postoperatively she received $\frac{1}{2}$ grain of morphine intravenously and her skin sutures were tied. The patient made an entirely uneventful convalescence, her temperature never going above 99.6° F., nor her pulse above 100. She was kept in the hospital twenty-one days because of her general depletion and the fact that she had a long trip home. At the time of discharge her bowels were moving twice daily.

section they are pinkish gray and granular. The tumor on section is gray coarsely granular with yellowish stippling. The regional lymph nodes show no evidence of metastasis.

Postoperative Course—The patient has done well and is symptom free one and one half years after operation. She has regained her lost weight and her bowels move easily twice daily.

Comment—This patient illustrates a typical instance of carcinoma of the right colon. The lack of obstructive symptoms associated with a palpable tender mass and anemia is often found. It was brought out in her family history that a sister had been operated upon for extensive tuberculosis of the pelvic organs. The tender right lower quadrant mass with weight loss made it necessary to consider tuberculosis in the differential diagnosis. Regional enteritis was also considered. Both of these were fully definitely ruled out by the roentgenologic examinations. A chest film revealed no evidence of tuberculosis. There was no narrowing of the terminal ileum and the lesion had the characteristic appearance of carcinoma.

At one time we felt that resection of the right colon with primary anastomosis at one stage carried a greater risk than a two stage attack. We still do a closed ileotransverse colostomy as a primary stage in cases with obstructing lesions of the right colon or when the patient is a particularly poor risk. We are however, better satisfied with the present one stage procedure. It seems apparent that the use of the long intestinal tubes for forty eight hours before and after operation is best adapted to the right bowel lesions.

Whether one does a lateral anastomosis in these cases rather than an end to end suture is a matter of choice. Some men prefer an end to side hook up. The important factors are a wide open lumen, no gross contamination, adequate blood supply and no tension on the suture line. With these principles in mind the results will be satisfactory by any method used.

CASE II CARCINOMA OF THE TRANSVERSE COLON

This 76 year old woman (M. C. H. No. 554373) had had constipation relieved by enemas for many years. Five months previous to admission she first noted severe crampy pains across the midabdomen coming on in attacks lasting four or five days and then subsiding. Two months before admission she first developed vomiting and her abdominal pains became more severe. There was radiation of pain into both flanks. For several months previous to admission she had taken nothing but finely ground food prepared for her by a devoted daughter. She had had acute glaucoma eight months previously which necessitated the enucleation of her left eye.

Physical examination revealed an edentulous elderly female. The left eye had been enucleated and the right eye revealed some evidence of glaucoma. In addition she was quite deaf. Her abdomen was distended and tympanitic; obstructive peristalsis was evident. Palpation revealed a definite movable mass in the mid abdomen just below the level of the navel. Her blood pressure was 200/90 but

otherwise, her examination was negative. X ray studies following a barium enema

showed a long segment of transverse colon almost completely obstructed. The mucosal pattern is destroyed over a 10 cm. area. She was placed on a liquid diet four times a day on possible to deflate her abdomen, and after four or five days she was having two stools a day. On the eighth day after admission, a laparotomy was performed under nitrous oxide gas-oxygen-ether anesthesia.



Fig 323—Barium studies in Case II, showing a long segment of transverse colon almost completely obstructed. The mucosal pattern is destroyed over a 10 cm. area.

Operation.—The abdomen was opened through a transverse incision across both rectus muscles above the umbilicus. The bowel was found to be well prepared. There was a large annular tumor involving the left transverse colon. There appeared to be no actual extension into the serosa, although the tumor mass was 20 to 25 cm. in diameter. The liver was entirely free of metastases and no gross lymph nodes were palpable in the mesocolon. The mesocolon was mobilized and a 21 cm segment of the transverse colon resected with

itoneum was closed with No 0 chrome catgut the fascia with interrupted No 30 cotton Sutures of heavy cotton were introduced 15 cm apart through skin fat and fascia to be tied forty eight hours later At the conclusion of the operation bilateral prophylactic superficial femoral vein interruption was done Finally the anus was carefully dilated

Pathologic Report: Adenocarcinoma grade II The regional lymph nodes were negative A 21 cm segment of large bowel including a central stenosing annular tumor mass occupying 6 cm of the bowel On section the tumor invades the entire thickness of bowel wall to a depth of 2.2 cm and extends into the adjacent fat Nine lymph nodes were identified measuring up to 0.8 cm in diameter and none of these contained tumor on microscopic examination

Postoperative Course—The patient did very well her temperature reaching 99.6° F over 1 from 1 day 1 day 1 operative day

Comment—This patient illustrates several interesting features In the first place we believe that it is more important to accomplish resections of the transverse colon in one stage than in any other segment of the large intestine The reason for this is based on the anatomic variations of the blood supply to this region Singleton⁸ has called our attention to the fact that the anastomosing radical from the left colocolic vessel to the midcolic artery is missing in certain individuals In the presence of complete obstruction a well placed cecostomy will not interfere with resection at a later date Temptation to use preliminary ileotransverse colostomy in lesions of the proximal segment of the transverse colon has led us into difficulty with the blood supply at the time of resection in one instance Healing of the turned in end of the midtransverse colon failed on account of the abnormal blood supply to the region If such a preliminary procedure is done the anastomosis should be placed well to the left of the midcolon

The prophylactic interruption of the deep veins of the legs is based on the fact that pulmonary embolism is a common cause of death in patients with carcinoma of the large intestine and in patients with chronic disease of the almost

after the interruption of the normal femoral veins if the procedure is carried out properly It seems obvious to us that the long loose bland thrombus that appears in the deep veins of the legs without demonstrable evidence is more common in patients of the older age group than in others Sudden death from this cause can be eliminated by

ophylactic interruption of the veins in cases that are likely to
up this complication

ly walking is practiced in nearly all of our surgical patients
of them, for one reason or another, cannot be given this added
ard to their recovery. Our impression is that a properly placed
utured wound will allow patients to move about during their
postoperative period to great advantage. The chiefest of these
maintenance of muscular and joint tone

CASE III. CARCINOMA OF THE DESCENDING COLON

a 31 year old married man (M. C. H. No. 536314) entered the hospital
the following story. Approximately thirty days before admission he first
a dull ache in his left lower quadrant. At this time he found a tender mass



324—Barium studies in Case III. There was a constant area of narrowing
junction of the descending colon and sigmoid which corresponds to the
the abdominal mass. The margins of the defect are sharply defined and
e but the lesions do not appear to be completely annular and there is
little evidence of mucosal destruction.

left lower quadrant. He was then recovering from a respiratory infection
un lasted a day or two and together with the tenderness disappeared. One
before admission he had a similar episode of pain and tenderness with
the mass. In this second attack the pain became progressively worse and
d him up. At this time the tenderness was quite marked and the mass
distinct. During the course of the night, his discomfort gradually passed off
at the aid of medication. On occasion while unnaating the discomfort was
sed. There were no other urinary symptoms. He had not complained of any
e in bowel habits but had lost 5 pounds over the past six months. He had
well in the past save for an appendectomy nineteen years previous to
tion.

The family history is interesting in that both his father and brother had had operations for "tumor of the bowel," two years and seven years previously.

He was immediately given sulfathalidine—2 gm four times a day—and a low roughage diet. Laboratory studies revealed a hemoglobin of 15.5 gm per 100 cc. Barium enema passed readily to the cecum and entered the terminal ileum. The findings are given in Figure 324. After evacuation of the enema more barium was introduced and the defect was confirmed by a second examination. The remainder of the colon appeared normal. The terminal ileum was not remarkable. The sigmoidoscope was passed well into the sigmoid (25 cm) and the mucosa appeared normal throughout. After seven days of sulfathalidine preparation operation was undertaken.

Operation.—Under spinal anesthesia, an oblique incision was made in the left lower quadrant. The rectus muscle was retracted mesially and the oblique muscles were split in the direction of their fibers. It was necessary to transect some of the internal oblique muscles' fibers. The liver was palpated and was free of metastatic nodules. The edge of the omentum was adherent to the tumor mass and was freed by resecting a portion of it, leaving the involved margin in contact with the tumor. The tumor itself was adherent to the anterior abdominal wall in the region of the internal inguinal ring. It was found necessary to remove that portion of the peritoneum and, during its removal, it was found that the vas deferens was densely adherent. Accordingly, a 2 cm segment of the vas with the underlying left spermatic artery and vein was also sacrificed. The bowel with its supplying mesentery was resected. Nodes were found to run up to the junction of the sigmoid and inferior mesenteric vessels. An open anastomosis was done using interrupted cotton sutures outside and a running fine chromic catgut suture within. The defect in the mesentery was closed. A delayed wound closure technic was used. The anus was carefully dilated to three finger breadths.

Pathologic Reports: adenocarcinoma, grade III, with metastases to six of nine lymph nodes. The highest lymph nodes were found involved. The specimen consisted of a 16 cm segment of large bowel containing a 3 cm long ulcerating tumor in its midportion with a hemorrhagic coarsely granular base and raised indurated edges. It involved half the circumference of the lumen and extended through the wall into the serosal fat. Lymph nodes were hard and measured up to 1 cm in diameter.

Postoperative course.—This patient was 44 years of age at the time of operation. He had been between the ages of 40 and 60. He was given small doses of sulfathalidine daily after operation and until his bowels moved satisfactorily on the fifth postoperative day. The rectum was kept clean by the use of 8 ounces of

Comment.—The family history, the youth of the patient, added to the high degree of malignancy and its extension, make for a bad prognosis. Could a more radical procedure have accomplished any more? There was a wide margin of normal bowel on either side of the tumor. All the mesentery supplying the region was removed. Would an attempt for a higher nodal dissection have been justifiable? Were there other lymph nodes involved that could have been removed? These questions are difficult to answer. All palpable nodes were included in the resection. This in itself is small proof that the spread of this process was not already out of bounds. It is discouraging to find a lesion giving such a short warning to be so fulminating in its character.

CASE IV. CARCINOMA OF THE RECTOSIGMOID

This 53 year old woman (M. C. II No. 533525) had noted episodes of bleeding at stool for nearly one year. At the onset she had gone to her physician who had done a barium enema which was reported as negative. She was found to have mild hemorrhoids. During the course of a year, she had a sensation of incomplete evacuation after moving her bowels. For the previous month there had been a dull aching low back discomfort. Her bowel habits had never been regular and she had taken cathartics about once a week most of her adult life. There was no real constipation or diarrhea. There had been no vomiting and no abdominal distention. No bleeding in large amounts. She had lost no weight. Her

physical examination revealed adenomatous polyps in the sigmoid colon and rectum. The cancer was found at the junction of the sigmoid and rectum.

Her photo hemoglobin was found to be 14.4 gm. per 100 cc. Her nonprotein nitrogen was 10.0 mg. per 100 cc. Her blood sugar was 100 mg. per 100 cc. Her cholesterol was 250 mg. per 100 cc. Her uric acid was 4.0 mg. per 100 cc. Her creatinine was 1.0 mg. per 100 cc. Her alkaline phosphatase was 10 units per 100 cc. Her lactic acid was 10 mg. per 100 cc. Her urea nitrogen was 10 mg. per 100 cc. Her bilirubin was 1.0 mg. per 100 cc. Her total protein was 7.0 gm. per 100 cc. Her albumin was 4.0 gm. per 100 cc. Her globulin was 3.0 gm. per 100 cc. Her sedimentation rate was 10 mm. per hour. Her blood type was A. Her Rh factor was positive. Her coagulation time was 10 minutes. Her clot retraction was good. Her fibrinogen was 2.0 gm. per 100 cc. Her prothrombin time was 10 minutes. Her partial thromboplastin time was 10 minutes. Her fibrinolytic activity was normal. Her serum electrolytes were within normal limits. Her serum calcium was 10 mg. per 100 cc. Her serum phosphorus was 4.0 mg. per 100 cc. Her serum potassium was 4.0 mEq. per liter. Her serum sodium was 140 mEq. per liter. Her serum chloride was 100 mEq. per liter. Her serum bicarbonate was 24 mEq. per liter. Her serum albumin was 4.0 gm. per 100 cc. Her serum globulin was 3.0 gm. per 100 cc. Her serum total protein was 7.0 gm. per 100 cc. Her serum albumin to globulin ratio was 1.0. Her serum cholesterol was 250 mg. per 100 cc. Her serum triglycerides were 100 mg. per 100 cc. Her serum lipoproteins were within normal limits. Her serum ferritin was 100 mg. per 100 cc. Her serum transferrin was 100 mg. per 100 cc. Her serum transferrin saturation was 100%. Her serum transferrin receptor activity was 100%. Her serum transferrin receptor activity index was 100%. Her serum transferrin receptor activity index was 100%.

a six day course of sulamethazine — gm. four times a day. On the day prior to operation a Miller Abbott tube using mercury in the balloon was introduced and on the day of operation it was well down in the small intestine.

Operation—A left paramedian incision was made. The liver was free of disease. The lesion was found just below the pelvic floor and could be felt through the peritoneum of the pouch of Douglas. The sigmoid was free laterally and divided in its lowest segment and the vessels and the lymphatics below the bifurcation of the iliacs were separated. No lymph nodes were palpable. Dissection was carried down to the coccyx. The lateral cardinal ligaments of the rectum were separated and the anterior surface of the rectum separated from the vagina, lengthening the rectum twofold. It was possible to place a clamp well below the lesion itself. An end to end open anastomosis was done, using an inner row of fine chromic catgut and an outer row of interrupted cotton sutures. The mesial peritoneal reflection was next sutured over the suture line medially and anteriorly, leaving the

lateral area open to allow escape of retroperitoneal fluid 100,000 units of penicillin were introduced locally The wound was closed in layers the fat and skin closure to be delayed forty eight hours The anus was finally dilated

Pathologic Report: Colloid adenocarcinoma grade II The lymph nodes were negative but the tumor had extended into a large serosal lymph vessel Thirty three centimeters of rectosigmoid had been removed Two centimeters above the distal resection edge is a raised cauliflower growth measuring 3 cm in diameter

Postoperative Course—The patient did well postoperatively On the first and third postoperative days her temperature rose to 100° F her pulse never exceeded 94 The Miller Abbott tube was removed on the second postoperative day She was continued on sulfathalidine postoperatively until the time of discharge on her twentieth day At the time of discharge the index finger palpated the anastomosis readily in the midrectum.

Comment.—The criticism that might be raised in this case is the advisability of restoring bowel continuity The patient was extremely apprehensive and had suffered for years with cancer phobia She had submitted elsewhere to needless excisions of portions of both breasts for cystic mastitis six years previously The growth as seen in the sigmoidoscopy, was small in size and the biopsy report revealed a fairly low grade adenocarcinoma We have frequently had to take into account the possibility of a more serious grading when the entire specimen was in the pathologist's hands The colloid element was a surprise but on the other hand, there was no spread to lymph nodes We are not aware of any cures in our hospital in colloid carcinoma of the colon and rectum no matter how extensive the operative procedure So far this patient has not had any local recurrence although

only 2 cm This in my opinion is too close for comfort and should local recurrence take place it will be due to our willingness to abide by the wishes of her family and physician to avoid colostomy A Miles procedure would have been better judgment in this case

CASE V. CARCINOMA OF SIGMOID WITH ENDOMETRIOSIS

This 49 year old bipara (M G II No 440316) was admitted to the hospital March 27 1944 She has always been constipated and for years has been troubled with hemorrhoids otherwise she has been vigorous healthy and active Normal menopause occurred eight months ago During the autumn of 1943 she was aware of occasional blood and mucus discharges from the rectum—almost always associated with bowel movement but recently this has occurred without stool and often with the passage of gas Seven weeks prior to entry she had a bout of severe abdominal cramps attributed to the ingestion of lobster This cleared up with the onset of diarrhea Her physician ordered a barium enema examination on March 10 which showed an obstructing lesion at the lower sigmoid and

much gas and fecal matter above the lesion in spite of a castor oil preparation (Fig 325) Sigmoidoscopy revealed bloody mucus coming down from an obstructed area 16 cm from the anal margin. A biopsy was attempted but was unsuccessful. Bimanually a large mass could be felt in the left pelvic region. It was not possible to outline the uterus separately from the mass as a whole. The cervix was eroded and bulbous.

The family history is of interest in that her mother now aged 78 had sigmoid resection for carcinoma three and one half years previous to the patient's entry. Her father's sister had succumbed to cancer of the rectum.

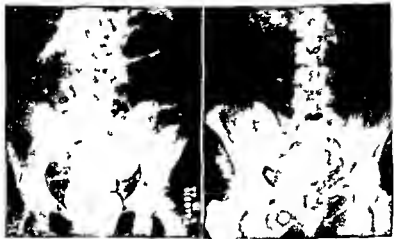


Fig 325—Barium enema in Case V shows an obstructing lesion at the lower sigmoid and much gas and fecal matter above the lesion.

Preparation was carried out by giving 3 gm of sulfathiazole and low irrigation daily for several days. Her red blood count of 3.5 million and doses of vitamin C were considerably increased. However, her preparation was probably inadequate. We were afraid to give her further cathartics since the previous castor oil had caused great distress and had little effect on cleansing the colon.

Operation—The first operation was an exploratory laparotomy and com-

pleted slightly above the pelvic floor and was attached firmly to the uterus. It was decided that resection at this time would be too hazardous in view of the poor bowel preparation. A transverse incision was therefore made through the upper left rectus and a loop of transverse colon brought out. The lower wound was carefully closed. The patient did

well after this procedure and it was possible to cleanse the lower bowel by irrigations through the distal orifice of the complete transverse colostomy. Irrigations of normal salt solution were supplemented by suspensions of sulfathalidine up to the day previous to the second operation.

The second stage was done April 18, fourteen days after the first, and consisted of resection of the sigmoid and panhysterectomy en bloc, followed by primary anastomosis of the descending colon to the rectosigmoid. The exploratory left paramedian wound was opened and extended, the bowel was found to be well prepared. The tumor mass consisted of a firm tennis ball sized tumor in the sigmoid loop firmly attached to a uterus containing fibroids and endometrial implants. The lateral gutter was opened and the left ureter, which was tortuous, was dissected free of adherent tissue believed to be due to the endometriosis and not to the sigmoid carcinoma. The ovarian vessels on the left were divided high and dissection carried down retroperitoneally into the pelvis. The inferior mesenteric vessels were then identified and interrupted just below the branch supplying the lower sigmoid. The bowel at this point was then divided between clamps with the actual cautery. Dissection was continued into the pelvis to well below the tumor in the sigmoid. The right ovarian vessels were then secured and the uterine vessels interrupted at a low level. The upper vagina was then cut across. This allowed the entire tumor mass with uterus, adnexa, and sigmoid to be lifted upward. The bowel was then divided between clamps with the cautery well below the tumor. An accurate end to end suture of the bowel ends was then accomplished using two rows of fine chromic catgut. Peritonealization was accomplished leaving most of the suture line of the anastomosis within the peritoneal cavity. A cigarette drain was introduced from above into the vagina, the proximal end of this rested in the denuded retroperitoneal space, great care being used not to allow contact between the drain and the suture line.

Pathologic Report: The specimen revealed a 23 cm. segment of sigmoid with its attached mesentery, the uterus, tubes and ovaries. In the center of the resected sigmoid was an encircling lesion 5.5 cm. in length with irregular, hard, raised edges. This tumor extended through the bowel wall where a secondary 2 cm. nod. he was attached to an other d.

... ..

Postoperative Course.—The patient was given a transfusion to replace blood lost during the operation. Intravenous water, glucose, vitamins and small amounts of sulfadiazine were given save an ounce of water to function well by the t.

much gas and fecal matter above the lesion in spite of a castor oil preparation (Fig 325) Sigmoidoscopy revealed bloody mucus coming down from an obstructed area 16 cm from the anal margin. A biopsy was attempted but was unsuccessful. Bimanually, a large mass could be felt in the left pelvic region. It was not possible to outline the uterus separately from the mass as a whole. The cervix was eroded and bulbous.

The family history is of interest in that her mother now aged 78 had sigmoid resection for carcinoma three and one half years previous to the patient's entry. Her father's sister had succumbed to cancer of the rectum.

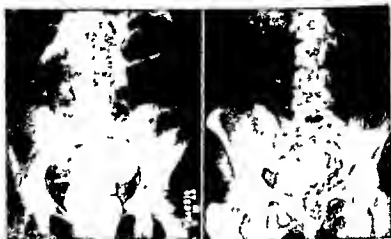


Fig 325—Barium enema in Case V shows an obstructing lesion at the lower sigmoid and much gas and fecal matter above the lesion.

Preparation was carried out by giving 3 gm of sulfathalidine and low irrigations daily for seven days. The patient was in good general condition having red blood count of 4 900 000 and 14.5 gm of hemoglobin per 100 cc. Large doses of vitamin C were added to a low residue diet. Her generalized distention was considerably improved and she was free of peristaltic pain. It was felt however that her preparation was probably inadequate. We were afraid to give her further cathartics since the pre x ray castor oil had caused great distress and had little effect on cleansing the colon.

Operation—The first operation, exploratory laparotomy and com-

slightly above the pelvic floor and was attached firmly to the uterus. It was decided that resection at this time would be too hazardous in view of the poor bowel preparation. A transverse incision was therefore made through the upper left rectus and a loop of transverse colon brought out. The lower wound was carefully closed. The patient di-

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resumed. The vaginal drain was removed on the third morning. The patient was sufficiently recovered by the eighth day to test the anastomosis with saline irrigations, which demonstrated unsatisfactory lumen. This procedure was repeated every four days thereafter until by the eighteenth day there was a free flow of irrigating fluid in both directions through the distal colon. The patient was then allowed to get up and about to regain some of her lost muscle tone.

The third procedure was closure of the transverse colostomy, which was accomplished thirty nine days after her first operation and twenty five days after her resection and anastomosis. The scar tissue about the colostomy was excised saving as much skin as possible. Both ends of the colostomy were freed from the peritoneum and delivered outside the wound. The colon was transected between clamps on both limbs in healthy areas well beyond all scar tissue. A careful end-to-end anastomosis was then made and the bowel dropped free into the peritoneal cavity. The peritoneum and fascia were closed with interrupted No. 30 cotton and the skin sutures tied forty-eight hours later.

The patient recovered well from this procedure and was discharged home ten days later on a normal diet. Her bowels were moving satisfactorily with small doses of mineral oil. She has remained well up to the time of this report.

Comment—In this patient, we used too little sulfathalidine in the preparation, later cases received larger doses with better effect. We have liked this drug better than sulfasuxidine because of its less liquefying action on the fecal matter. We might have been able to reestablish continuity earlier had we used interrupted nonabsorbable sutures in the anastomosis as has been our custom for over two years. We would not institute any drainage in such a case today, having found that the peritoneal cavity takes care of any serous discharge from the denuded areas, if the peritonealization is limited to the mesial side of the dissection, leaving the lateral gutter open. Drains in previous cases either through the ischial fossa, the vagina or the abdominal wall have contributed to complications such as fistula formation or stenosis at the point of anastomosis. Neither of these has occurred since we abandoned the use of drains. This low anastomosis

carried out by us. The almost complete obstruction and the patient's temperament, plus the error in using catgut in the anastomosis all played a role in the prolonged convalescence.

32.6 per cent in forty six one-stage resections in Orr's collected series, and the four deaths in twenty three cases (17.4 per cent) reported by Waugh and Clagett

Six patients were discharged from the hospital. All are now dead, the longest survival being thirteen months and the average seven months (Table 2)

Two Stage—Fourteen two stage resections were done. One patient died following the first stage and three after the second stage procedure, giving an operative mortality of 29 per cent (Table 1). This is similar to Orr's figure of 28 per cent for fifty seven two-stage resections. Waugh and Clagett had two deaths in seven resections, or 29 per cent.

Ten patients were discharged from the hospital alive following two stage resection. Two are living, one eight months and one five years after operation. Of the remaining eight, the longest survival was four teen months (two cases) and the average was seven months (Table 2)

TABLE 2

LENGTH OF LIFE OF FORTY FOUR SURVIVORS OF OPERATION

	Discharged Alive	Now Living	Dead	Average Survival (Months)
One-stage resection	6	0	6	7
Two-stage resection	10	2 (8 mos., 60 mos.)	8	7
Exploratory laparotomy	10	1 (21 mos.)	9	2
Palliative operation	18	2 (each 6 mos.)	16	5

Following both one stage and two stage resections, sixteen patients left the hospital alive. Two are living as noted in the preceding paragraph. The other fourteen are dead, having survived an average of seven months. Orr's report showed an average survival of ten months for twenty three patients who were dead when reported.

Inoperable Cases—There were forty patients in this group. Twelve had only an exploratory laparotomy. Two died following operation (17 per cent) and one is living twenty-one months after operation. The remaining nine patients died with an average survival time of two months. The one living patient had a tumor involving the tail of the pancreas, proved by biopsy (Tables 1 and 2).

Twenty-eight patients had palliative operations. These consisted usually of some form of choledochostenterostomy. Occasionally a gastroenterostomy was done, or a combination of the two procedures. Three patients could not be traced. Seven died postoperatively (25 per cent), two are living—each six months after operation—and sixteen are dead.

THE STATUS OF PANCREATICODUODENAL RESECTION

MARSHALL K. BARTLETT, M.D., F.A.C.S.*

THE work of Whipple, Parsons and Fullins,⁶ published in 1935 stimulated a lasting interest in radical resection of the duodenum and pancreas for malignant disease involving the region of the ampulla of Vater and the head of the pancreas. Since that time many contributions to this subject have appeared in the literature and a fairly uniform concept of the management of such problems is developing.

Whipple⁶ collected sixty-four pancreaticoduodenal resections up to April 1, 1942 and in December 1944, Orr² presented a comprehensive

series of cases in 1945. In the same year Cattell¹ published his experience with eighteen cases, five of which had been included in Orr's series. Waugh and Clagett⁴ presented an analysis of thirty cases in 1946.

The purpose of his paper is to review the results of radical pancreaticoduodenal resection at the Massachusetts General Hospital from August 1941 to January 1, 1947 and to evaluate the procedure from the standpoint of operative mortality and life expectancy following operation.

During the period under study a diagnosis of carcinoma of the pancreas ampulla of Vater or duodenum was made in the case of seventy-eight patients. Of these sixty-five or 83 per cent were subjected to operation. Twenty-five cases were suitable for radical pancreaticoduodenal resection. This is 38 per cent of the patients operated upon or 32 per cent of the entire group which corresponds closely with the operability rate suggested by Cattell.¹

Radical Resection—One Stage.—Of the twenty-five radical pancreaticoduodenal resections in this series eleven were done in one stage. Five patients died following operation giving an operative mortality of 45 per cent (Table 1). This is higher than the figure of

TABLE 1
OPERATIVE MORTALITY IN SIXTY-FIVE PATIENTS

	No. of Cases	Died Following Operation	Operative Mortality (per cent)
One-stage resection	11	5	45
Two-stage resection	14	4	29
Exploratory laparotomy	12	2	17
Palliative operation	28	7	25

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With constantly improving means of preoperative preparation of the jaundiced patient and with the accumulating technical advances in the handling of the various anastomoses involved in pancreaticoduodenal resection, it is reasonable to expect a considerable improvement in operative mortality.

More adequate methods are needed for evaluating the degree of liver damage in the patient with long standing jaundice. This would help in distinguishing those who must be relieved of biliary obstruction by the simplest possible means, prior to a radical attack on the tumor, from those who can safely undergo a one stage operation.

If the operative mortality can be kept at a reasonable level, there are definite advantages to a one stage resection. The length of hospitalization is decreased, the dangers of two separate anesthetics and two operations and the technical difficulties caused by extensive adhesions frequently encountered at the second operation are avoided.

The sole advantage of the two stage operation is that it offers the opportunity of relieving the obstructive jaundice and restoring the flow of bile into the intestinal tract in a relatively simple manner, thus rendering the patient a better risk for a radical attack on the malignant tumor. In certain cases this advantage must continue to be of paramount importance. It outweighs the disadvantages of the two stage procedure and dictates the choice of this type of operation for these patients.

SUMMARY

1 From August 1941 to January 1, 1947 the diagnosis of carcinoma of the pancreas, ampulla of Vater or duodenum was made in seventy eight

2 (83 per cent)
and 38 per cent of
cases operated on or 32 per cent of the entire group)

3 The operative mortality and length of life following one stage and two-stage pancreaticoduodenal resection and palliative operations have been reported.

4 The location of the primary tumor and the presence or absence of lymph node metastases had no demonstrable effect on the survival period in this small series of cases.

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Of these sixteen, the longest survival was ten months and the average five months (Tables 1 and 2)

Orr's figures showed an operative mortality of 39.4 per cent for palliative biliary enteroanastomosis done on 158 patients. The average length of life of 186 traced patients was nine months.

Length of Hospital Stay.—The number of hospital days for patients who had one stage, two stage and palliative operations is shown in Table 3. As would be expected a two stage resection greatly prolonged the hospital stay.

TABLE 3
AVERAGE NUMBER OF DAYS IN HOSPITAL

	Died Following Operation	Discharged Alive
One-stage resection	15	43
Two-stage resect on	57	70
Palliative operation	21	30
	33	60

Location of Tumor.—In the twenty five patients upon whom radical resection was done, the primary tumor was in the pancreas in thirteen, the ampulla of Vater in ten and the duodenum in two. This is a higher proportion of pancreatic lesions than in some of the reported series.

In theory because of its location, a tumor of the ampulla should give serious symptoms sooner and thus lead to earlier operation with a more favorable outlook. This is not borne out in this small series of cases. Of the two living patients one had a pancreatic lesion and one an ampullary growth. The average survival period of the remaining patients in the two groups was identical (eight months). Lymph node metastases were found with equal frequency in both types of tumor in the patients subjected to radical resection.

COMMENT

On the basis of results obtained to date it is evident that the treatment of patients having malignant lesions of the pancreas or ampullary region is far from satisfactory. The fact that a palliative anastomosis offers symptomatic relief and a life expectancy nearly as great as that obtained by radical resection cannot be offered as an argument in favor of a procedure which makes no attempt to eradicate the underlying disease.

Poor as the results have been, the only logical attack on these malignant lesions available at the present time is a radical resection of the entire duodenum, the head of the pancreas and as much of the adjacent lymphatic bed as possible. Far from serving to condemn this approach to the problem, the unsatisfactory results so far obtained must provide a challenge to continued effort along these lines.

THE THERAPY AND PROPHYLAXIS OF VENOUS THROMBOSIS AND PULMONARY EMBOLISM

GORDON A. DONALDSON, M.D., F.A.C.S.*

OVER the past five years the literature on the subject of thrombophlebitis and embolism has become voluminous. This enthusiasm has been shared in by surgeon, obstetrician and internist alike, and it is just becoming evident that the measures, both therapeutic and prophylactic, which have followed in the wake of this interest are producing results. At the Massachusetts General Hospital in 1925, there were three deaths from massive fatal pulmonary embolus following every 1000 operations.¹ Ten years ago, with the introduction of more careful attention to the position of the patient on the operating table, active and passive leg exercises postoperatively, encouraged deep breathing, routine elevation of the foot of the bed to speed venous return, and finally earlier ambulation, the incidence of fatal embolism had dropped to one death in 800 operations. In 1945, twenty years after Davis' observations, there were nine proven fatal emboli following 9765 operations. This ratio of slightly less than one to one thousand was maintained in 1946, when there were nine deaths after 9969 operative procedures.

It has been adequately demonstrated that age greatly influences the incidence of postoperative pulmonary embolism. In a previous report,² it was found that patients in the sixth decade of life were most susceptible, and this has been adequately corroborated by others. In the fifteen year period from 1930 the mean age of patients admitted to the Massachusetts General Hospital has risen from 36 years 3 months to 42 years 3 months, an increase of six years. Again, it is obvious that the magnitude of the operative procedure has a direct bearing on the incidence of phlebitis. The relatively recent development of modern anesthesia resources, technical operative facilities, and better understanding of - - - combined to extend the survival time of Trousseau,³ the ament disease has been recognized. The development of phlebitis in the presence of cancer has come to be known as "Trousseau's sign."

* Assistant Surgeon, Massachusetts General Hospital. Assistant in Surgery, Harvard Medical School, Boston.

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is not constant. We believe that the extremes of acute thrombophlebitis on the one hand and "bland thrombosis" of Homans or "phlebothrombosis" of Ochsner and DeBakey on the other, are expressions of an identical process. Between them are all gradations, the picture at the moment depending on the extent of involvement of vein intima in the inflammatory process. Most often the inflammatory reaction is an aseptic one, and the extent of endothelial damage is dependent on such factors as the degree of local anoxia and general alterations in the cellular and fluid constituents of the blood which tend to increase clotting proficiency. At one extreme is found diffuse swelling, tenderness, warmth and pain in the calf on dorsiflexion of the foot. The superficial veins over the ankle and forefoot are distended, and there is a leukocytosis, elevated sedimentation rate and fever. Here the clot is firmly adherent to the vein wall over some distance and the likelihood of a large, death producing embolus is slight. This type, if it does not kill by several repeated smaller emboli, enforces a prolonged hospital stay and results in a permanently impaired leg due to valvular destruction.

The gradations of the bland asymptomatic thromboses are many. Minimal swelling of the ankle, local areas of point tenderness, a sense of firmness in the tissue of the calf, slight fullness of the long saphenous vein at the ankle, associated with mild systemic reaction indicate that the clot coagulum is adherent to only a small area of vessel intima. Propagation is chiefly cephalward and when the thrombus does free itself a long column of clot is liberated to the right heart and pulmonary arteries.

THErapy

The many reports on the effectiveness of one form of treatment against another tend to be misleading. In fact, the therapeutic procedures available today should be used depending on the case at hand to supplement one another rather than be considered as rival forms of therapy. Rational treatment of established thromboembolic disease may take one or more of three forms, the use of anticoagulant drugs, lumbar sympathetic procaine block, or deep vein interruption. The use of heparin and dicumarol is based primarily on the prevention of the extension of thrombosis until such time as the established coagulum becomes more strongly organized to itself and to the vessel wall and until the patient is adequately ambulatory to insure a vigorous venous flow. Lumbar sympathetic block, on the other hand, rapidly and effectively increases venous return by interrupting reflex arterial spasm resulting from the irritating venous inflammatory process. The disappearance of leg swelling and pain is often dramatic, as the normal arteriovenous gradient is regained. Finally, deep vein interruption properly performed above the level of the thrombus precludes the

In 1930 patients with malignant disease comprised 10.3 per cent of total surgical admissions to the hospital, whereas in 1945 this figure had risen to 16.5 per cent. It is thus evident that any measures which have lessened the incidence of embolism in recent years have done so against steadily increasing obstacles.

The importance of the tibial veins and their tributaries below the level of the knee as the source of most pulmonary emboli has now become well established. Adequate support for this contention comes from the pathologist and clinician. In the last decade, pathologists have shown that where postmortem examination of the legs is thoroughly made, ante mortem thrombosis is found in the deep veins of the calf in over 50 per cent of all cases.^{4, 5} In the older individual the incidence rises. In 200 routine autopsies performed in an old folks' home, the deep veins of the legs were found thrombosed premortally in 90 per cent of the cases. Much of this thrombosis, of course, was the result of enforced bed rest and in no sense the cause of death. In a second series of cases, Hunter and his associates⁶ indicated that recumbency is the greatest single factor in thrombus formation. In a group of patients exercised systematically until shortly before death, only 18 per cent exhibit thromboses at autopsy as opposed to 53 per cent when exercise was not emphasized. Simpson's observations further incriminate the leg veins. Pulmonary embolism was strikingly increased in elderly persons cared for in London bomb proof shelters who reclined in chairs for long hours with pressure on the calf and popliteal vein.

On the clinical side pulmonary emboli arising from the leg veins as a source, are becoming recognized by symptoms and signs often regarded in the past as indicative of primary disease of the heart or lungs or as an inconsequential digestive disturbance. A single symptom in itself is not sufficient to make the diagnosis but often enough calls attention to the presence of other obscure signs which give added evidence of the presence of vascular pathology. At the Massachusetts General Hospital² 59 per cent of patients presented leg signs as first indication of thromboembolic disease and of these 67 per cent showed leg swelling, 61 per cent tenderness over the tibial vessels, and 42 per cent a positive Homans sign. The remaining 41 per cent presented chest symptoms as first indication of disease.

We have come to put great reliance on the appearance of the clinical chart. Any patient who otherwise convalescing smoothly, suddenly develops a simultaneous rise in temperature, pulse and respiration is suspected of harboring phlebitis or of having a subclinical pulmonary embolus until proven otherwise. In a small series of cases 81 per cent of charts considered suitable for study demonstrated this positive "Allen sign."

It has become evident that the picture of deep leg vein thrombosis

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unless such factors as cardiac incompetency or malnutrition are present, swelling is not permanent. Its severity and persistence are directly proportional to the extent the phlebotic process is allowed to attain before interruption is done. In the past two years, earlier diagnosis has been the rule, and with proper after care in the form of elevation and supportive bandages ankle edema has not been bothersome. In

TABLE 2

INCIDENCE OF THERAPEUTIC AND PROPHYLACTIC FEMORAL VEIN INTERRUPTION IN 1587 CASES

Massachusetts General Hospital 1937 to January 1947

	Therapeutic	Prophylactic		Total
1937-1942	202	0	0%	202
1943	150	15	9%	165
1944	208	72	26%	280
1945	214	178	45%	392
1946	259	289	53%	548
Total	1033	554		1587

the occasional case exhibiting a spread of the inflammatory process in the leg vein tributaries after interruption, lumbar block with or without dicumarol has controlled both pain and swelling. In the older group because of altered electrolytes, cardiac incompetency, inadequate venous structures or lymphatic sclerosis, vesper edema, dependent on osmotic and hydrostatic factors has persisted as long as

TABLE 3

COMPLICATIONS OF FEMORAL VEIN INTERRUPTION IN 1587 CASES

Massachusetts General Hospital 1937-1946

Incidence of sepsis	13	0.8%
Incidence of hemorrhage	9	0.6%
Incidence of lymphorrhea	26	1.6%
Incidence of postphlebotic ulcer	2	0.1%
Incidence of pulmonary infarct	63	4.0%
Incidence of fatal embolism	6*	0.4%

* Five of these cases were in the therapeutic group

six months. Two in the group of 1033 patients carry postphlebotic ulcers. It is difficult to evaluate what effect vein interruption has had on the life history of these lesions in view of the work of Buxton and Coller⁹ on the use of this procedure in the treatment of the postphlebotic syndrome. Subsequent pulmonary emboli have been encountered in 4 per cent of cases, necessitating the use of supplemental dicumarol. It is of interest that practically all of this group who

possibility of further propagation of fatal embolism. All three forms of therapy reduce the period of convalescence, mitigate the sequelae of untreated thrombosis, and lower the incidence of fatal embolism. In some instances, it is obvious all three may be employed to advantage on the same patient.

Homans⁸ was the first clinician to call attention to the feasibility of interruption of the femoral vein in the groin to prevent pulmonary infarction. The method has found many enthusiastic advocates in this country. From 1939 to January 1947 at the Massachusetts General Hospital, there have been 1692 patients who have been subjected to femoral vein interruption, representing a total of 3185 vein operations (Table 1). It is worthy of note here, that in not a single instance has

TABLE I
FEMORAL VEIN INTERRUPTION IN 1587 PATIENTS
Massachusetts General Hospital, 1937-1946

	Patients	Veins	Unilateral Interruption	Bilateral Interruption
1937	1	1	100 0%	0%
1938	0	0	0%	0%
1939	8	8	100 0%	0%
1940	5	5	100 0%	0%
1941	51	55	92 1%	7 9%
1942	137	211	46 0%	54 0%
1943	165	299	19 0%	81 0%
1944	280	554	2 1%	97 9%
1945	392	781	0 8%	99 2%
1946	548	1091	0 9%	99 1%
Total	1587	3005		

a patient lost life or limb as a result of the procedure. One hundred and five of these cases were operated upon in treatment of the sequelae of an old phlegmasia, and will not be discussed further in this paper.

Approximately two-thirds of the group have been treated for acute thromboembolic disease, the remaining patients representing interruptions done as a prophylactic measure (Table 2).

In those patients treated for acute disease, the results have been
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 at an earlier date, resulting in a great saving of needed beds. The amount of residual edema of the legs has not been disturbing and

trol the occasional case in which the acute phlebitic process spreads throughout the leg and the more astute use of anticoagulants to control the 4 per cent of postinterruption emboli functionally normal legs should be preserved and mortality from this disease should be eliminated

PROPHYLAXIS

The results in therapy noted above represent a great advance in the prevention of pulmonary embolism once a warning venous accident has occurred in the form of venous thrombosis or a benign pulmonary embolus. In spite of this progress it remains that death may occur from sudden and unheralded pulmonary embolism. It is in an effort to eliminate such events that prophylactic measures have been elaborated. Over the past two years this basic incidence of embolism from unrecognized bland or phlebothrombosis has been attacked at the Massachusetts General Hospital in a controlled group of patients by the routine prophylactic use as indicated of dicumarol or femoral vein interruption.

Sudden massive embolism under the age of 40 years is unusual. There have been four such cases in our clinic over the past six years and these have occurred chiefly on the Medical Services. That bland thrombosis may develop in this younger group particularly as the result of trauma is stressed by Hamilton and Angevine¹⁷ who report ninety-nine such fatalities in soldiers under the age of 40. Certainly in civilian life it may be considered a relatively rare postoperative complication.

In those patients over 40 years of age three factors are of great im-

These age groups compare with those reported by Evans and Boller¹⁸ who found over a similar six year period a total of fifty-two fatalities, seventeen of these occurring in the sixth and fourteen in the seventh decades of life. The nature of the primary illness is also of significance. Debilitated patients, those suffering from cancer, intestinal obstruction and general old age are prone to develop bland thrombi in their leg veins as the result of venous stasis. Finally, the initial operative procedure must be considered. Veal¹⁸ has demonstrated convincingly the surprising frequency of fatal embolism following low thigh amputation. Here particularly the entire length of the superficial femoral vein lies quiescent as a nidus for thrombus formation. By the simple expedient of prophylactic vein interruption, Veal has been able to lower the mortality in comparable groups of patients from 42.1 per cent to 17.5 per cent. Patients with fractures about the hip region offer opportunity of a similar proportion. Because of medicolegal intervention, autopsy proof of embolism is often lacking, but the clinical

suffered subsequent emboli had been subjected to vein interruption because of a previous pulmonary infarction. Five patients in the group of 1033 therapeutic interruptions succumbed to proven subsequent emboli. In none of these earlier cases was anticoagulant therapy used as an adjunct. Four of the five had had pulmonary infarctions prior to interruption, resulting in a lowered pulmonary reserve so that lesser subsequent emboli were adequate to cause death (Table 3).

It would be helpful if, in each case of early deep venous thrombosis, the morbidity or mortality could be known. This is difficult to evaluate because from different areas of the country come various statistics. In our own clinic, Miller and Rogers¹⁰ prior to 1929 found seven deaths in 206 cases of thrombophlebitis. One hundred and three of these cases were of spontaneous origin, the remaining 50 per cent being postoperative. Welch and Faxon¹¹ in a later study found the death rate to be almost identical, the ratio of fatal embolism to phlebitis being one in twenty-five. Three fifths of their cases of deep phlebitis followed operation or trauma. In 1946, with present day therapeutic measures fairly well established, the ratio of autopsy proven fatal embolism to clinical thrombophlebitis had fallen to 1 in 130. There were two failures in 259 cases of thromboembolic disease. One hundred fifty two cases, or essentially three-fifths of the total again, occurred following operation or trauma, and each of the fatalities occurred in this group. In these surgical cases the ratio remains 1 to 76, or a mortality of 1.3 per cent. That this figure reflects the true picture is borne out by statistics of 1945 in which there were two fatalities in 214 instances of phlebitis. Operation and trauma contributed 136 of these cases and were responsible for both deaths.

Ochsner and DeBakey¹² feel safe in the continued use of procaine sympathetic block. This has proved effective in their southern climate. Bauer's¹³ results in Sweden with the use of repeated intravenous

are encouraging. Evans and Boller¹⁶ report two fatalities from embolism in 127 cases of postoperative phlebitis following the combined use of both heparin and dicumarol, occasionally resorting to femoral vein interruption when indicated.

With the judicious use of one or more of these agents of therapy available, it is not out of reason to suppose that fatalities in the pres-

with the adjuncts of lumbar sympathetic block and dicumarol to con-

period of strict bed rest are given an additional 200 mg. before the expected fall in prothrombin time has resulted

As might be expected, depending on liver competency, the prothrombin response to dicumarol has been markedly variable. In an occasional case, the increase in prothrombin time after only 200 mg. has been frightening, and we have been tempered in our earlier enthusiasm to increase the size and frequency of dosage. It is a good general rule, that when the prothrombin time response is twice the "normal reading," the prothrombin content of the blood is reduced to 30 per cent of normal and serious bleeding may ensue.²¹ Certain individuals, on the other hand, respond poorly to this dosage. Rarely, however, has phlebitis developed in such cases, and it is our distinct

TABLE 4

CONTRAINDICATIONS TO DICUMAROL THERAPY

of 1999	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100	101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120	121	122	123	124	125	126	127	128	129	130	131	132	133	134	135	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150	151	152	153	154	155	156	157	158	159	160	161	162	163	164	165	166	167	168	169	170	171	172	173	174	175	176	177	178	179	180	181	182	183	184	185	186	187	188	189	190	191	192	193	194	195	196	197	198	199	200	201	202	203	204	205	206	207	208	209	210	211	212	213	214	215	216	217	218	219	220	221	222	223	224	225	226	227	228	229	230	231	232	233	234	235	236	237	238	239	240	241	242	243	244	245	246	247	248	249	250	251	252	253	254	255	256	257	258	259	260	261	262	263	264	265	266	267	268	269	270	271	272	273	274	275	276	277	278	279	280	281	282	283	284	285	286	287	288	289	290	291	292	293	294	295	296	297	298	299	300	301	302	303	304	305	306	307	308	309	310	311	312	313	314	315	316	317	318	319	320	321	322	323	324	325	326	327	328	329	330	331	332	333	334	335	336	337	338	339	340	341	342	343	344	345	346	347	348	349	350	351	352	353	354	355	356	357	358	359	360	361	362	363	364	365	366	367	368	369	370	371	372	373	374	375	376	377	378	379	380	381	382	383	384	385	386	387	388	389	390	391	392	393	394	395	396	397	398	399	400	401	402	403	404	405	406	407	408	409	410	411	412	413	414	415	416	417	418	419	420	421	422	423	424	425	426	427	428	429	430	431	432	433	434	435	436	437	438	439	440	441	442	443	444	445	446	447	448	449	450	451	452	453	454	455	456	457	458	459	460	461	462	463	464	465	466	467	468	469	470	471	472	473	474	475	476	477	478	479	480	481	482	483	484	485	486	487	488	489	490	491	492	493	494	495	496	497	498	499	500	501	502	503	504	505	506	507	508	509	510	511	512	513	514	515	516	517	518	519	520	521	522	523	524	525	526	527	528	529	530	531	532	533	534	535	536	537	538	539	540	541	542	543	544	545	546	547	548	549	550	551	552	553	554	555	556	557	558	559	560	561	562	563	564	565	566	567	568	569	570	571	572	573	574	575	576	577	578	579	580	581	582	583	584	585	586	587	588	589	590	591	592	593	594	595	596	597	598	599	600	601	602	603	604	605	606	607	608	609	610	611	612	613	614	615	616	617	618	619	620	621	622	623	624	625	626	627	628	629	630	631	632	633	634	635	636	637	638	639	640	641	642	643	644	645	646	647	648	649	650	651	652	653	654	655	656	657	658	659	660	661	662	663	664	665	666	667	668	669	670	671	672	673	674	675	676	677	678	679	680	681	682	683	684	685	686	687	688	689	690	691	692	693	694	695	696	697	698	699	700	701	702	703	704	705	706	707	708	709	710	711	712	713	714	715	716	717	718	719	720	721	722	723	724	725	726	727	728	729	730	731	732	733	734	735	736	737	738	739	740	741	742	743	744	745	746	747	748	749	750	751	752	753	754	755	756	757	758	759	760	761	762	763	764	765	766	767	768	769	770	771	772	773	774	775	776	777	778	779	780	781	782	783	784	785	786	787	788	789	790	791	792	793	794	795	796	797	798	799	800	801	802	803	804	805	806	807	808	809	810	811	812	813	814	815	816	817	818	819	820	821	822	823	824	825	826	827	828	829	830	831	832	833	834	835	836	837	838	839	840	841	842	843	844	845	846	847	848	849	850	851	852	853	854	855	856	857	858	859	860	861	862	863	864	865	866	867	868	869	870	871	872	873	874	875	876	877	878	879	880	881	882	883	884	885	886	887	888	889	890	891	892	893	894	895	896	897	898	899	900	901	902	903	904	905	906	907	908	909	910	911	912	913	914	915	916	917	918	919	920	921	922	923	924	925	926	927	928	929	930	931	932	933	934	935	936	937	938	939	940	941	942	943	944	945	946	947	948	949	950	951	952	953	954	955	956	957	958	959	960	961	962	963	964	965	966	967	968	969	970	971	972	973	974	975	976	977	978	979	980	981	982	983	984	985	986	987	988	989	990	991	992	993	994	995	996	997	998	999	1000	1001	1002	1003	1004	1005	1006	1007	1008	1009	1010	1011	1012	1013	1014	1015	1016	1017	1018	1019	1020	1021	1022	1023	1024	1025	1026	1027	1028	1029	1030	1031	1032	1033	1034	1035	1036	1037	1038	1039	1040	1041	1042	1043	1044	1045	1046	1047	1048	1049	1050	1051	1052	1053	1054	1055	1056	1057	1058	1059	1060	1061	1062	1063	1064	1065	1066	1067	1068	1069	1070	1071	1072	1073	1074	1075	1076	1077	1078	1079	1080	1081	1082	1083	1084	1085	1086	1087	1088	1089	1090	1091	1092	1093	1094	1095	1096	1097	1098	1099	1100	1101	1102	1103	1104	1105	1106	1107	1108	1109	1110	1111	1112	1113	1114	1115	1116	1117	1118	1119	1120	1121	1122	1123	1124	1125	1126	1127	1128	1129	1130	1131	1132	1133	1134	1135	1136	1137	1138	1139	1140	1141	1142	1143	1144	1145	1146	1147	1148	1149	1150	1151	1152	1153	1154	1155	1156	1157	1158	1159	1160	1161	1162	1163	1164	1165	1166	1167	1168	1169	1170	1171	1172	1173	1174	1175	1176	1177	1178	1179	1180	1181	1182	1183	1184	1185	1186	1187	1188	1189	1190	1191	1192	1193	1194	1195	1196	1197	1198	1199	1200	1201	1202	1203	1204	1205	1206	1207	1208	1209	1210	1211	1212	1213	1214	1215	1216	1217	1218	1219	1220	1221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picture is no less graphic. In our clinic we have grown to respect and fear the group of patients with cancer of the gastrointestinal tract, esophagus, stomach, colon and rectum. Prostatic surgery carries a relatively high risk, and only less so small bowel obstruction, pelvic tumors, breast cancer and biliary tract disease.

In an attempt to formulate a program which would be both effective and practically applicable to the hospital laboratory, a control study was carried out at the Massachusetts General Hospital. The plan entailed combining the use of prophylactic dicumarol and prophylactic vein interruption, and the study was continued over the years 1945 and 1946. The two identical Surgical Services in the General Hospital itself made ideal controls. The East Surgical Service under Arthur W. Allen sponsored the experiment, and the West Surgical Service under E. D. Churchill and L. S. McKitttrick cooperated as the control.

Following major surgery on the East Service, dicumarol was administered prophylactically to the middle age group, aged 40 to 65, and those older were routinely subjected to prophylactic femoral vein interruption. Reported subarachnoid, gastrointestinal, and renal accidents subsequent to the use of anticoagulants in the arteriosclerotic, elderly people, particularly in the presence of hypertension, led us to prefer vein interruption as less dangerous. The age limit of 65 was somewhat flexible. In instances where the incidence of phlebotrombosis was known to be high, as after thigh amputation and resections of the rectum or stomach, femoral vein interruption was preferred to the use of dicumarol in some patients younger than 65. Except for an occasional unavoidable prophylactic interruption, the West Surgical Service obligingly served as a control, reserving the therapeutic procedure for those patients who developed recognizable thromboembolic phenomena. That these two Service groups were admirably suited for comparison can be seen from the admission data in Table 5.

That dicumarol is a specific liver poison cannot be overemphasized.

In our clinic, we have been conservative in that only 200 mg. has been

genitourinary, gynecologic and private service patients have been treated. As of January 1, 1947, there had been a total of 247 patients treated with dicumarol and 554 prophylactic femoral vein interruptions. The complications encountered following dicumarol in this small group is evident in Table 6.

TABLE 6

COMPLICATIONS OF PROPHYLACTIC DICUMAROL IN 217 PATIENTS

Massachusetts General Hospital, 1945-1946

Minor bleeding	9
Major bleeding*	1
Phlebitis†	5
Pulmonary infarct†	7
Fatal pulmonary embolus	0
* Requiring vitamin K and transfusion	
† Requiring femoral vein interruption	

The vein interrupted in each instance has been the superficial femoral. Of the 554 patients undergoing this procedure, fifteen have developed clinical phlebitis in one leg or the other, as measured by findings other than swelling, namely, pain, tenderness, dorsiflexion discomfort, or a general systemic response. In this group of 554 there has been one postinterruption fatal embolus, proven at autopsy. This patient was an obese 63 year old woman with a large ventral hernia. Two days after hernioplasty, vein interruption was done. Thirteen days later, a left middle lobe infarct was demonstrated by x-ray. Sudden death ensued two days thereafter. This misfortune occurred in 1945, and since then we have adopted two measures which would have been of value. The superficial femoral vein should be tied with care, flush with the profunda so as to leave no nidus for thrombus formation. There was a 3 cm nidus in the above case. Secondly, today she would be given heparin and dicumarol, following her initial warning pulmonary infarct. We feel that this patient demonstrates further that given a normal pulmonary circulation, the short profunda and common femoral vessel thrombi cause death by repeated insults to the lung, rather than harboring a single thrombus large enough to produce a sudden fatal result.

The value of prophylactic interruption becomes more tangible when cases so treated are compared with a like group drawn in sequence from our hospital files (Table 7). The records have been consecutive. Age, sex, disease, operative procedure, and service in the hospital, whether public or private, have been matched as accurately as possible. Under these limitations it has been necessary to search as far back as 1939 and 1941 respectively for comparable hip fractures and leg amputations. Prophylactic vein interruptions were practically universal in both these groups from 1943 to the present. The remain-

trol group, on the other hand, contributed three such fatalities in the same period

In the older patients, because it was felt that superficial femoral vein interruption held fewer hazards than the use of dicumarol all patients subjected to major surgery were prophylactically ligated. This procedure was done in some cases, particularly those in which the patient had been bedridden at home or who had a prolonged course of preoperative study, prior to major surgery. In others it was feasible to interrupt the veins at the time of operation and in the majority "prophylaxis" was accomplished within forty eight hours after operation. Actually, due to the temporary venous congestion in

TABLE 5

INCIDENCE OF POSTOPERATIVE PHLEBITIS AND FATAL EMBOLISM IN THE PROPHYLACTIC-TREATED AND THE CONTROL GROUPS
Massachusetts General Hospital 1945-1946

East Service (Dicumarol 40-64 Vein Interrup- tion 65+)		I	II	III	Total
		1 39 yrs	40-64 yrs	65+ yrs	
	Prophylactic dicumarol	0	223	0	223
	Prophylactic interruption	1	35	181	217
	Postoperative phlebitis	9	9*	8†	26
	Fatal embolism	0	0	0	0
	Admissions	1136	1299	497	
West Service (Control)	Prophylactic dicumarol	0	0	0	0
	Prophylactic interruption	0	14	5	19
	Postoperative phlebitis	9	15	17	41
	Fatal embolism	0	3	3	6
	Admissions	1163	1280	433	

* Five of the 9 died.

channel as follows:

more than forty eight hours elapse particularly in individuals who have been bedridden preoperatively. One hundred eighty-one such

not convinced of the value of prophylaxis, many of the orthopedic,

measure is employed. One per cent procaine anesthesia is adequate. The skin incision is strictly vertical, parallel with major blood and lymph vessels, from the groin crease distally for a distance of 8 to 10 cm. The pulsating femoral artery in the groin crease gives an excellent guide, regardless of obesity. Subsequent incisions are carefully maintained in a vertical dissection, thus making it possible to displace the main femoral lymphatic vessels and nodes medially, without entering them. Transverse and oblique incisions are to be avoided as there inevitably is injury to lymphatic structures, resulting in postoperative lymph edema of the leg and lymph drainage from the wound.

The medial margin of the sartorius muscle next makes an excellent guide to the underlying femoral sheath. The entire sheath is carefully retracted laterally without baring the artery itself, thus exposing the vein which lies more posteriorly than medially at this level. Before grasping the vein, the fossa through which the profunda escapes is first identified. Unnecessary injury to the common femoral vessel is thus avoided. Several landmarks are helpful. In the normal subject the bifurcation of the common femoral should lie in the middle of the wound, if properly made. In most individuals a bulge can be detected just below this level, indicating the site of a valve in the superficial vein. This valve lies within 1 to 2 cm. of the actual bifurcation, and is almost constantly present. Finally with careful blunt scissors dissection, a definite fossa will be found posteriorly through which the profunda femoris runs in a slightly medial direction. Above and lateral to the vein, the profunda artery can often be felt running parallel to it.

Exposure of the upper 2 cm. of vein to be interrupted is sufficient. In spite of the presence of one or more heavy muscular branches entering directly posteriorly it is possible with the aid of a right angle clamp to pass No. 00 chromic guy ligatures about the superficial vein, between the levels of profunda femoris and posterior muscular

above and below as possible. Thrombi which have been present for a day or two at this level as foreshadowed by early swelling of the thigh are often difficult to remove completely. Following aspiration, the vein is completely divided between clamps, and the proximal ligature is carefully placed flush with the entrance of the profunda branch. For safety sake, the cut vein ends are further secured with stitch ligatures distal to the original ties.

In closure of the wound it is important to make an accurate three layer approximation of deep fascia, superficial fascia and skin. Escape of some lymph into the wound is inevitable, and lymph cyst or transient lymphorrhea sometimes occurs. Care must be exercised not to

ing series were in addition matched year by year. The findings are corroborated by a group of amputations collected by Veal¹⁸ and support a similar, overlapping series reported earlier.²²

TABLE 7

COMPARATIVE INCIDENCE OF POSTOPERATIVE THROMBOSIS AND EMBOLISM
Older Age Group of Patients

	Number of Cases in Each Group	With Prophylactic Vein Interruption		Without Prophylactic Vein Interruption	
		Phlebitis	Fatal Embolus	Phlebitis	Fatal Embolus
Fractures h.p. region	114	3	0	20	10*
Leg amputation	57	0	0	2	1
Gastric operations	59	2	0	5	4
Colon operations	62	1	0	5	5
Small bowel obstruction	9	1	0	1	1
Cholecystectomy	38	0	0	5	1
Resection rectum	32	2	0	7	1
Hernioplasty	28	1	1	3	1
Pelvic surgery	76	0	0	3	2
Prostatectomy	17	0	0	2	1
Radical mastectomy	18	0	0	1	0
Heart disease	21	0	0	4	0
Appendectomy	10	1	0	1	0
Gross dissection	8	0	0	0	0
Study cases	8	0	0	0	0
Esophagectomy	6	0	0	1	0
Common duct exploration	6	0	0	0	0
Resect on papercut	4	1	0	2	0
Leg abscess, leg fracture, arched anastomosis each	3	1	0	1	0
Lung abscess, peritonitis, popliteal aneurysm each		0	0	0	0
Wound-healing	16	2	0	1	0
Total	554	15	1	63	30

* Because of medical legal jurisdiction a autopsy was not possible; all deaths followed h.p. fractures.

TECHNIC OF OPERATIONS

The operation of femoral vein interruption should not be considered too lightly. Although we have had no serious complications following the procedure in our own group, instances of loss of an extremity are reported in the literature.^{23, 24} In the poorly nourished thin individual the technical procedure is relatively simple, requiring perhaps thirty or forty minutes. In the short stout patient vein interruption may be time-consuming and hazardous. Venous anomalies in the area are frequent, and preliminary acquaintance with the region should be had by precept or by autopsy experience before undertaking the procedure. Although reported elsewhere,²⁴ certain details of the technic are worthy of emphasis.

The patient should lie in slightly reverse Trendelenburg position to give increased local positive venous pressure. Infarcts during the manipulation of the vein have not occurred, but this precautionary

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include in interrupted ligatures the femoral nerve which lies deep to the deep fascia and the medial or anterior femoral cutaneous nerves lying deep to the superficial fascia. After a change of instruments and gloves a similar procedure is carried out on the other leg.

As the diagnosis of thrombophlebitis in the last year or two has been made earlier fewer thrombi have been encountered at operation. If the process has extended to involve the profunda as determined by palpation of the vein a similar guy ligature technic is used to explore this vessel. In those patients on whom it is not possible to establish free retrograde bleeding through the common femoral, we have come to feel that supplemental anticoagulant therapy in the form of heparin and dicumarol should be used until the patient is fully ambulatory. Intervention at the iliac or inferior vena caval level in comparison is unnecessarily hazardous and carries a disturbing morbidity and a forbidding mortality.² Vena cava ligation in our clinic is now reserved for patients presenting septic emboli the source of which is or has extended above the femoral level.

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It may be said at the outset that in no instance have we observed 100 per cent sensory regeneration following transection of a nerve. Although, objectively, tactile appreciation appears to be equal with the uninjured side, there is always a qualitative difference. It is possible that we have not observed the lapse of enough time, as in several instances improvement apparently was still taking place several years after a good result may be said to have been attained.

We have been able to follow only about 70 per cent of the nerve injuries seen long enough to determine the end result (Table 1). Of the 171 so followed, 85 per cent have been considered as having a good result. Those patients in whom the result was poor have been studied in order to determine where possible the cause of the failure of regeneration.

TABLE 1

RESULTS IN 212 CASES OF INJURY TO NERVES OF THE ARM

	Total No of Cases	End Result Determined in		Good		Poor
		No	Per Cent	No	Per Cent	No
Sutured	172	121	70	103	83	18
Neurolysis	70	50	71	43	86	7
Total	242	171	70	146	85	25

Ulnar Nerve Injuries—Injuries to the ulnar nerve comprise the largest group. The vast majority of these injuries took place at the wrist, so that most of the intrinsic muscles of the hand were denervated. This, while it produces considerable deformity, results in relatively little incapacity if proper splinting measures to counteract the hyperextension of the metacarpophalangeal joints of the fourth and fifth fingers are taken. The function of the two outer lumbricals and the adductors and abductors returned consistently, but lagged behind sensory regeneration. The adductors to the fifth finger returned in only two instances and these were both in young children. We attribute this failure in large part to improper splinting.

Sepsis apparently played no part in the poor results, as in seven instances where gross sepsis occurred following operation good regeneration took place. One patient deserves special mention in this connection. A 35 year old woman was cut deeply across the forearm in three places. At operation the ulnar nerve was found transected in two places 4 cm apart. Both lacerations were sutured. On her second postoperative day she developed frank gas gangrene of her forearm, and much débridement was necessitated. For about ten days the su

REGENERATION IN THE ULNAR, MEDIAN AND RADIAL NERVES

EDWARD HAMLEN, JR., M.D., F.A.C.S.* AND ARTHUR L. WATKINS, M.D.†

INTEREST in surgery of the peripheral nerves received a tremendous impetus during the last war. Numerous papers have been published dealing for the most part with new techniques of sutures and new methods for determining whether or not regeneration is taking place in an injured nerve. It is too early yet for a definite appraisal of the results secured. Our interest in the expected statistical analysis of war injuries has led us to review the experience obtained at the Massachusetts General Hospital. Peripheral nerve injuries seen at this hospital during the years 1931 to 1940 have been previously published.¹ To these we have added the cases observed during the years 1941 to 1945 inclusive.

There are many difficulties associated with an appraisal of the results of peripheral nerve surgery, a very long follow up period is required, the various observers record their data in a completely ununiform manner frequently difficult of interpretation, most difficult of all is the definition of what constitutes a good or a poor result. Pollock and Davis² point out in the collection of reports they have assembled from twenty one authors that no two are in agreement as to the criteria to be used in distinguishing a good from a poor result. Most of these authors, in fact, do not specify what measurement they have employed. In our previous paper we defined a good result as that which left the individual with an extremity suitable for use in everyday life. It is obvious that what would satisfy a day laborer might be totally unsuitable for a musician, so we have tried to determine what the requirements of a useful extremity are. Clearly, in the leg, function is almost the sole requisite. In the hand we have ruled that areas of anesthesia should be classed among the poor results, and certainly inability to carry out normal activities, such as writing, dressing and eating, should also be so classed. Thus when we speak of a "good result" following repair of a median or an ulnar nerve, it signifies that there is complete sensory regeneration and sufficient motor regeneration to obviate gross impairment of function. If a radial or peroneal nerve is in question, return of motor function is all that is required.

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treated was somewhat less. The results were not quite so good, but it should be emphasized that the poor results were all in the earlier series.

The number of injuries to digital nerves was greater than in the ulnar group but comprised less than one-half the total and many of these patients were "lost" and the result undetermined. Unless the median nerve was injured at the elbow or above, serious motor impairment was limited to the opponens pollicis muscle as the adductor of the thumb and the first two lumbricals when paralyzed produced but little disability. We have perhaps erred in classifying as good results those in four patients on whom a Bunnell type of tenorrhaphy to provide opposition of the thumb was performed prior to the expected time of regeneration. The nerves in every instance did regenerate. The

TABLE 3
RESULTS IN NINETY FOUR CASES OF INJURY TO THE MEDIAN NERVE

	Total No of Cases	Results Determined in		Good		Poor
		No	Per Cent	No	Per Cent	No
Sutured	81	60	74	53	88	7
Neurolysis	13	9	69	9	100	0
Total	94	69	73	62	89	7

operation was done to provide useful function of the hand and so decrease the duration of disability. It is of interest that we have seen ten instances in which division of the median nerve at levels higher than the wrist has not resulted in opponens pollicis paralysis. Either the motor branch has arisen from a higher level than is usually supposed or the muscle has been innervated by another nerve. In one instance a patient with ulnar and radial palsy, but with intact median nerve, developed opponens pollicis paralysis.

One patient is of special interest. Both median and ulnar nerves had been transected in the forearm one year before and repair attempted at an outside hospital. There was return of sensation to the median area and a peculiar phantom type of sensation in the ulnar distribution. At operation it was found that the proximal ulnar nerve had been sutured to the distal median. Because of the good result it was decided not to sacrifice what had been gained and accordingly the proximal median nerve, which had been . . . was sutured to the distal . . . seen the patient had g . . . felt

tured ulnar nerve lay exposed in the wound. Finally skin grafts were done and the nerve went on to good sensory regeneration.

It is doubtful whether age is an important prognostic factor for whereas those patients with good results averaged 28 years old, the seven with poor results averaged only 32 years old. Of the six patients over 50 years, all did well.

The time interval between injury and operation is frequently stated to be important from a point of view of prognosis. We have failed to substantiate this as regards immediate versus delayed suture. Most of our patients are referred from elsewhere and there is an average lapse of about seven months following their injury before we see them. No statistical difference could be determined between the results in this group and those seen immediately following injury. Six of our

TABLE 2
RESULTS IN 106 CASES OF INJURY TO THE ULNAR NERVE

	Total No of Cases	Results Determined in		Good		Poor
		No	Per Cent	No	Per Cent	No
Sutured	68	41	61	42	95	2
Neurolysis	38	26	68	21	80	5
Total	106	70	66	63	90	7

patients were not seen for more than two years following injury and one individual had allowed four years to pass. All had successful regeneration.

An attempt was made to ascertain the rate of regeneration. This is difficult because measures of distance and time are both approximate.

bedded in it. In the other the operative note clearly indicated that too much tension was allowed at the suture line.

In the five failures following neurolysis the nerves in all had been transplanted anterior to the elbow for ulnar palsy attributed to old elbow injuries. In one the nerve was accidentally severed and not re-

nerve Three of the other poor results of suture occurred very early in the fifteen year period and it appears probable from the operative note that the technic employed was not as we would now perform it

In two instances the dorsal interosseous branch was divided as it arborized to the extensor muscles and the separate nerves were sutured to the proximal trunk In both instances there was good return of function

As in the other nerves, neither the age of the patient, the time interval from injury to operation nor the presence of sepsis appeared to influence the outcome of the nerve suture, although the cases are too few in number to attempt statistical analysis

In the thirteen patients whose radial nerves were merely freed from scar, the results were much better In one of the two poor results it appears probable that the damage was so extensive that resection and suture should have been done

TECHNIC

In the operations tabulated above we have neither originated nor employed any departure from standard surgical practice We believe that the only criteria of a successful suture are identification of the severed ends, careful trimming until all scar has been excised, meticulous approximation by means of fine interrupted sutures through the epineurium alone and sufficient freeing of the nerve and careful splinting of the limb so that tension is obviated If these measures can be carried out we believe a successful result will follow in almost every instance The exact methods employed or the type of suture material used, as long as it be fine, is in our opinion of little consequence

Departures from the above practice have on the whole been unsuccessful in our hands Tantalum foil wrapped around the suture line in three patients required excision of the resulting neuromas in each instance Our experience with suturing neuromas together under tension and later stretching the nerve by extension of the already flexed joint in order to obtain sufficient length for end to end suture has been unsuccessful on two occasions Nerve grafts have failed in three instances

Following suture a plaster cast is applied to fulfill two purposes, the first is to protect the suture line from untoward tension and the

faithful and cooperative and no small part of our success should be attributed to that fact The patients are then followed in the Hand Clinic for as long a time as is necessary and are referred back to the hospital when further surgical procedures are advisable

with his little finger he would also feel in his thumb and vice versa. This effect was decreasing. He had weak regeneration of his motor components also and was classed as a good result.

In the instances where both median and ulnar nerves were sutured at the same operation, the regeneration usually lagged behind in one nerve or the other, neither nerve being a consistent winner.

The age of the patient played no part in median regeneration, for the average age of patients obtaining good results was over 30 and of those with poor results 23.

The time interval between injury and operation appeared to be of little more importance in the median than in the ulnar group, for although in five of the poor results the injuries were over three weeks old when sutured, yet fifteen were over six months old yet good results were obtained. In one instance in which the injury was of four teen months' duration at the time of suture regeneration occurred

TABLE 4
RESULTS IN THIRTY-SIX CASES OF INJURY TO THE RADIAL NERVE

	Total No of Cases	Results Determined in		Good		Poor
		No	Per Cent	No	Per Cent	No
Sutured	20	15	75	7	46	2
Neurolysis	16	13	81	11	84	8
Total	36	28	77	18	64	10

at the rapid rate of 170 mm. in eighty six days or about 2 mm. a day. The average rate of regeneration was estimated to be 1.09 mm. a day. The slowest was 0.5 mm. a day.

that four out of the eight poor results in suture were directly attrib

The response of muscle to repetitive stimulation is of importance. The frequency at which there is complete fusion of individual twitches or tetanus varies with the contraction time of the individual muscle. Some muscles require as many as 350 stimuli per second as compared with 30 for the soleus. This tetanic response of normal muscles to repetitive stimulation should not be confused with the response of muscles to continuous currents of high intensity. When a normal muscle is stimulated with a current in the neighborhood of ten times the rheobase value it fails to relax during the passage of the current. This sustained response of muscle to direct currents of high voltage is known as galvanotonus or galvanic tetanus.

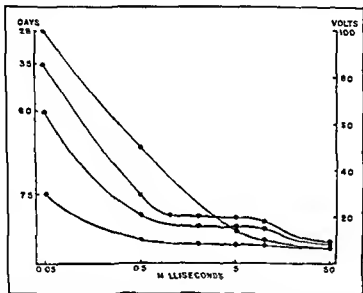


Fig. 326—Peripheral nerve lesion. Strength duration curves show slight decrease in irritability to currents of long duration and a break in shape of curve as indications of beginning regeneration on 35th day and further improvement on 60th and 75th days.

Clinical Tests—Electrodiagnostic tests are used to determine severity of lesions and presence of regeneration. The classical test of Erb is well known but one limitation needs emphasizing, namely, that even in the presence of complete severance of a peripheral nerve the paralyzed muscle continues to show normal electrical reactions for a period of four or five days as a minimum and may not show characteristic reaction of degeneration before two weeks. The simple test for reaction of degeneration may serve to distinguish some mild peripheral lesions from those requiring surgery. More delicate tests

At the present time the Hand Clinic is composed of the Chiefs of Neurosurgery, Orthopedic Surgery, Plastic Surgery and the Department of Physical Medicine and a general surgeon so that the patient has the benefit of varying experiences and opinions.

The Department of Physical Medicine has been of inestimable assistance, not only in the rehabilitation of injured hands, but also because it can tell the surgeon whether regeneration or degeneration is taking place in the individual case. This is done by means of electrical tests, a description of which follows.

ELECTRODIAGNOSIS

There has been considerable progress recently in clinical electrophysiology made possible by developments in electrodiagnostic instrumentation. In order to understand the methods employed it will be well first to review our present knowledge of neuromuscular physiology.

Electrical Excitability—The exact nature of the process of excitation is not known but certain phenomena are well established. When the environment of a portion of nerve or muscle cell is altered by an adequate outside force, a disturbance spreads to all portions of the cell called excitation. It is accompanied by an electrical wave which may be recorded. The magnitude of the response is completely independent of the strength of the stimulus, provided the stimulus is strong enough to produce a response. Excitation then is a force sufficient to start release of energy which then propagates itself along the whole nerve or muscle cell. The stimulus has a minimal strength or threshold value and a large proportion of our investigations of nerve and muscle action is concerned with this threshold value of excitation.

We commonly use electrical currents to produce excitation, for we can measure the magnitude and duration with precision and with no important injury. When a constant current passes through a nerve the threshold is decreased at the cathode, called *catelectrotonus*, and

form what is known as a strength-duration (SD) curve.

If the strength of the stimulating current is increased gradually instead of abruptly there results a decay of electrotonus or accommodation preventing excitation. Normal nerves or muscles tolerate slowly increasing currents of very high intensity, but this power of accommodation is altered with disease and injury.

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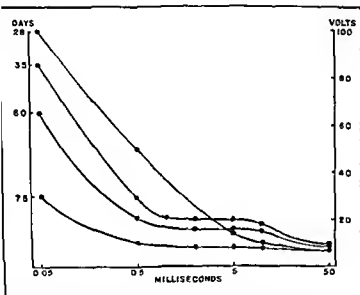


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at threshold intensity of current drops from a range of 30 per second to 8 to 10 with denervation and returns to the normal value with reinnervation (Fig 327) The results are different if a sine wave is used because at slow frequencies the increase in potential is so gradual that accommodation affects the results

Electromyography.—Another important recent development is the clinical use of cathode ray oscilloscopes or other amplifiers to record the tiny electrical discharges from muscles known as action potentials During slight voluntary contraction, action potentials of moderate frequency and voltage can be recorded and assume a characteristic appearance Partially denervated muscles may discharge only occasional individual diphasic spikes indicating some motor unit activity even without visible contraction The completely denervated muscle produces no action potentials but there are extremely low voltage, short duration impulses of characteristic appearance known as fibrillation of denervation It is thus possible by means of electromyography to determine partial from complete lesions and to pick up evidence of regeneration before it can be detected by other means

SUMMARY AND CONCLUSIONS

This report summarizes the results in 171 injured ulnar, median and radial nerves at the Massachusetts General Hospital during the years 1931 through 1945 Eighty five per cent were considered to have shown satisfactory end results based on arbitrary criteria Ulnar nerves successfully regenerated in 90 per cent, median in 89 per cent, and radial in 64 per cent of their total numbers It could not be established that the age of the patient, the presence of infection in wounds, or the time interval between injury and operation had material bearing upon the eventual outcome

The methods of determining the presence of regeneration or denervation in an injured nerve by electrical means are discussed

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are necessary, however, in determining the presence of reinnervation. The SD relationship of excitability has been found useful particularly with the newer types of square wave generators. This curve consists of at least two distinct types of excitabilities designated as alpha and gamma, the former having slower characteristics. The gamma curve is the result of indirect stimulation of muscle through intramuscular nerve fibers, while the alpha curve represents excitation of muscle fibers directly. The usual SD curve of normal muscles is smooth corresponding to intramuscular nerve fibers. During regeneration, however, it is possible to differentiate between alpha and

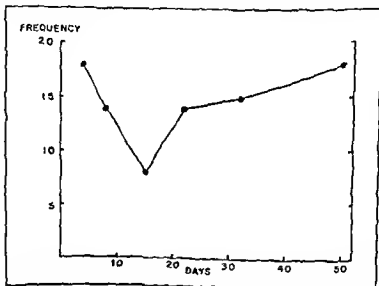


Fig. 327—Tetanic threshold frequency. Same patient as in Fig. 326. Stimulation with square wave impulses of 50 milliseconds duration and slightly supra threshold intensity. Frequency just necessary to produce visible fusion of contractions charted. Changes during degeneration and regeneration.

gamma curves as a break or discontinuity is observed. Presence of such alterations in the shape of the SD curve serves as an indication of reinnervation usually before there is functional evidence of regeneration (Fig. 326).

Strength Frequency Curve—The normal response of muscle on volitional stimulation is of course a tetanic contraction. By using repetitive stimulation with currents of threshold intensity the threshold frequency for tetanic response can be plotted in the form of a strength frequency curve. When the wave form of the stimulation is that of a square top the frequency necessary to produce a tetanic contraction

wall The anterior wall is longer and more prominent because it contains the hernial sac Protrusion of the peritoneum of an abnormally deep cul de sac through the pelvic fascia is characteristic of, and probably the chief underlying factor in, the production of a complete prolapse of the rectum Moschcowitz² described this condition very clearly in 1912 together with the surgical procedure which bears his name, and which will be discussed later A prolapse involving only the mucous membrane, usually encountered in elderly people in association with a relaxed sphincter, or seen as a prolapse of internal hemorrhoids, rarely protrudes over an inch from the anus, is rela-



Fig 328.—Complete prolapse of twenty years duration Note the characteristic circular folds and depressions which distinguish it from a mucosal prolapse

tively smooth and does not present the degree of thickness to palpation which one finds in a complete prolapse of the entire rectal wall

Etiology.—The conception of this condition as primarily a herniation of the cul de sac of Douglas through the pelvic fascia, based on a weakness of the fascia in this area, either congenital or acquired seems to explain best the sequence of events which follow and which may be considered as results rather than causes of the prolapse The presence of a deep cul de-sac, with the rectum on a short mesentery within the peritoneal cavity instead of lying below the peritoneal reflection in the pelvis, is a constant finding in these cases The external manifestation of the prolapse, and the dilated and weakened

PROLAPSE OF THE RECTUM

E. PARKER HAYDEN, M.D., F.A.C.S.*

COMPLETE prolapse, or procidentia, of the rectum presents a problem in surgical treatment which has never been very satisfactorily solved. Although fairly good results can be obtained by each of several different methods, the percentage of recurrence, also, is high in most of them when used singly, and to a lesser extent when several operations are combined.

Difficulties in assessing the value of these various surgical procedures arise from the following facts: (1) The total number of cases is relatively small. (2) They are spread among a number of surgeons so that the total experience of any one individual is limited. (3) So many different procedures have been tried that no one surgeon has accumulated a convincing series of cases operated upon by any one method or by the same combinations of several methods. For these reasons there may be some value in attempting to determine, from the combined experience of the surgeons of the Massachusetts General staff, which of the various procedures alone or in combination, give the most promise of producing lasting results.

In 1939 a study was made of twenty three cases which comprised the total number treated surgically in the Massachusetts General Hospital in the twenty-one years—1912 through 1933.¹ I have been able to find thirty seven additional patients who have been subjected to various surgical procedures by members of the Massachusetts General staff through the year 1946 making a combined total of sixty cases available for study.

There is bound to be a little confusion in the cataloging of cases of prolapse of the rectum as to whether they were complete or whether only the mucous membrane was involved. Only cases of undoubted prolapse of the entire rectal wall are included in this group.

The differential diagnosis of the two types should not be difficult though in several cases there seemed to be some doubt in the surgeon's mind as to whether he was dealing with a complete or a mucous membrane prolapse. Any prolapse which rolls outward from the anus for 2 inches or more, with a diameter of at least 2 inches, and which exhibits circular furrows and ridges on its surface, is a complete prolapse, involving all coats of the bowel wall (Fig. 323). The apex of the prolapse is always pointed somewhat posteriorly due to the greater length of the anterior as compared with the posterior

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wall. The anterior wall is longer and more prominent because it contains the hernial sac. Protrusion of the peritoneum of an abnormally deep cul de sac through the pelvic fascia is characteristic of and probably the chief underlying factor in the production of a complete prolapse of the rectum. Moschcowitz⁷ described this condition very clearly in 1912 together with the surgical procedure which bears his name and which will be discussed later. A prolapse involving only the mucous membrane usually encountered in elderly people in association with a relaxed sphincter or seen as a prolapse of internal hemorrhoids rarely protrudes over an inch from the anus. is rela



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sphincter, are results of the internal herniation. A higher incidence of prolapse in females (44 to 16) in this series, and the fact that in several there was a definite history of the prolapse occurring soon after other pelvic surgery—chiefly hysterectomy—suggests that the stretching incident to childbirth, aided by the weakening or removal of normal pelvic supports by surgical measures, apparently precipitated the prolapse in these women who already had deep cul-de sacs.

Age Incidence—We know that prolapse occurs in children and in this series of cases there were several adults whose symptoms dated back to childhood and were of very long duration the longest being forty years and the shortest eight weeks. The youngest patient, at time of operation was 14 and the oldest 84 with the largest group of seventeen patients in the sixth decade. There were eleven patients in the seventh decade. Five others were over age 70 when submitted to surgery.

Symptoms—The history in respect to symptoms varied considerably in the emphasis which different patients placed upon the various aspects of their difficulty. In some the *inability to control their evacuations* was stressed while others were annoyed by the *aching discomfort* of the protrusion and the necessity of manually replacing it. *Bleeding* due to chafing occurred in some instances and nearly all objected to the mucus discharge for which pads were sometimes worn. These are all symptoms which one would naturally expect from a turning inside out of the rectal ampulla and are of no special significance.

Treatment—*In Children*—It would seem from published reports that something can be accomplished with children by training methods involving the use of a narrow slit like toilet seat to prevent wide separation of the buttocks in straining at stool. Adhesive strapping of the buttocks between movements has also been tried. It is my impression that no very careful follow up of children with prolapse of the rectum has been carried out into their adult life. There is also considerable uncertainty as to whether prolapse in children is of the entire rectal wall or only of the mucosa or in what proportion each type occurs.

Good results in children have likewise been reported from the use of *linear cauterization of the prolapse* one of the largest series having been reported by Corbett.³ We have had no experience with the condition in children at the Massachusetts General Hospital and Dr. Allan Butler,⁴ Chief of the Children's Medical Service states that he rarely, if ever, sees a prolapse of the rectum on the service. Ladd and Gross⁵ mention the subject only briefly. In our series of sixty cases however, a girl of 19 had had her prolapse for "many years" whereas another, aged 23 had had it for only three years and a man of 25 for only two years. Another man of 20 said he had the prolapse

in infancy, and a man of 28 for 'years,' whereas a girl of 14 gave a history of only nine months duration. Whether the memory was at fault in some of these is a matter of conjecture.

In Adults—It can be stated with conviction that complete prolapse in adults is successfully treated only by surgery, and the cases herein reported were all subjected to one or more surgical procedures. In fact so many different procedures, single or combined, were employed and by so many different surgeons, that an accurate evaluation of results is difficult. The sixty cases were operated upon by twenty-three surgeons, the largest number done by any one being eighteen.

TYPES OF OPERATIONS

The operative procedures fall into two general groups—those carried out through the abdomen and those directed at the prolapse from below. So far as possible the cases have been subdivided in an effort to determine the types of operations which seem most likely to give good results.

Obliteration of the Cul-de-sac of Douglas (Moschcowitz Procedure).—The Moschowitz operation, in which the very deep cul-de-sac is obliterated by successive purse string sutures of heavy silk, was performed in forty-three of the sixty cases, either alone or in combination with other procedures. Moschcowitz,² in his description of the pathology and of his procedure, included a fixation of the uterus to the anterior abdominal wall, when feasible, but did not include any type of fixation of the sigmoid because he considered that to be unnecessary.

Of the forty three cases in the series subjected to the Moschcowitz procedure, in only six was the operation done by obliteration of the cul-de-sac. In the remaining thirty-seven cases, the operation was done by different methods, including fixation of the uterus to the abdominal wall, fixation of the left pelvic wall (eight cases), and ventrofixation or round ligament fixation (eight cases).

In two cases the operation of obliteration of the cul-de-sac was carried out a second time because of recurrence of the prolapse. In each case the silk purse string sutures had pulled out, in one patient only on one side of the pelvis. The length of time between operations was nine years in one case and two and one half years in the other.

Mikulicz resection of a redundant sigmoid was carried out in four cases, with later closure of the double-barrelled colostomy, without disengaging the bowel from the abdominal wall. This, of course, produces a very good ventrofixation of the sigmoid.

Also, in combination with the Moschcowitz procedure and its variations within the abdomen, some of our patients were operated upon from below, either previously, at the time, or later by one or more of the *posterior fixation operations*

Posterior Fixation Operations.—These consisted of (1) The Lockhart Mummery operation (petrolatum gauze packing in posterior rectal space) (2) The Tuttle operation (fixation by sutures)

Perineorrhaphy.—In several cases, also, a perineorrhaphy was included, and in several others a combined suture of the levators and sphincteroplasty, as described by Maes and Rives⁸

Amputation of the Prolapse—1 *Compression Ligature*—We have had experience in only one case with the type of ligature operation described by Reid,⁷ in which a piece of garden hose is anchored in the prolapsed rectum and an encircling ligature applied close to the mucocutaneous junction to slough off the prolapse and produce a spontaneous anastomosis. Our single case did well but developed some degree of residual prolapse in six months, perhaps mostly of the mucosa

Smith,⁸ at the Free Hospital for Women, in Boston, has operated upon nine women by this method without a fatality and with apparently good results though some degree of stricturing occurred in nearly all. One died five months later of sepsis incidental to dilatation of the stricture. This procedure necessitates care to be sure the hernial sac in the anterior wall of the prolapse is free of any intra abdominal organ before applying the compression ligature

2 *Excision*—Miles⁹ has been the chief advocate of direct surgical excision of the prolapsed bowel with closure of the hernial sac and suture of the various layers of the bowel wall to restore continuity. He reported thirty four cases with one death and only five recurrences. This procedure was carried out in only two patients in our series. One died three months later of probably unrelated causes and the other remains untraced

Reefing the Muscular Wall (The De Lorme Operation).—In our series the De Lorme¹⁰ operation was utilized in nine cases, either

⁴ and can be sutured.

The De Lorme operation is well suited to elderly people and can be carried out with safety if the bleeding which is likely to be very free, is well controlled by the operator

RESULTS

A study of the follow-up data on these cases emphasizes again the difficulty of drawing very definite conclusions as to which surgical procedure, or combination of procedures, can be relied on to produce the best results for the longest period of time. There are so many variables, as mentioned previously, that no tabulation of value can be made.

There is the question first as to what constitutes a good surgical result in these cases. Many of them retain some degree of mucous membrane prolapse, with laxness of the sphincter, even though the rectum itself remains in place. Some were quite happy about the result while others were annoyed by the residual mucosal prolapse which produced some moisture as before operation. Several said that their rectum no longer came out but that they had a feeling of heaviness or fullness in the anal region. This residual mucosal prolapse can be greatly improved if not entirely corrected, by either excising it or by tightening the anal sphincter, or both. Since the first is an unclear operation, and the second dependent for its success on securing primary healing of the sutured sphincter, it is obvious that the two procedures should not be done at the same time.

Moschcowitz Procedure.—The results following the Moschcowitz operation varied a great deal, with and without its various modifications and additions.

1 *Closure of the Cul de sac Alone*—Of the six cases in which obliteration of the cul-de-sac without any modification or addition was carried out, the results were as follows: One could not be traced, one recurred in six months, one in two years, while three reported no recurrence after four, five and thirteen years.

2 *Repetition of the Cul de sac Closure*—Mention has been made of the two recurrent cases in which a second obliteration of the cul-de-sac was performed because the sutures of the previous operation had pulled out. This is not surprising when one recollects how often suspensions of the uterus give way unless very securely sutured to the fascia and how common are recurrences of hernias anywhere in the body.

In most of the cases mentioned above, the same situation as existed in the two cases just mentioned. It seems unlikely, though possible.

3 *Fixation of the Uterus*—Fixation of the fundus to the anterior abdominal wall in eight cases was accompanied by perineorrhaphy in one (no follow up), fixation to sacrum in four (two recurred in one year to some extent but one is not too bad after seven years. One has had no recurrence in five years), fixation of sigmoid to uterus and

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In most of our recurrent prolapse cases however it apparently did not occur to the surgeon to repeat the obliteration of the cul de-sac. One can only conjecture as to whether exploration would have revealed in all of them the same situation as existed in the two cases just mentioned. It seems unlikely though possible.

3 *Fixation of the Uterus*—Fixation of the fundus to the anterior abdominal wall in eight cases was accompanied by perineorrhaphy in one (no follow up) fixation to sacrum in four (two recurred in one year to some extent but one is not too bad after seven years. One has had no recurrence in five years) fixation of sigmoid to uterus and

lateral wall in three (one recurred in one year, the other two reported no recurrence after three and five years)

4 *Suspension of the Uterus*—It was difficult to determine exactly how the suspension was done in all of these nine cases but that factor may not be important. No data could be obtained in three cases two recurred in three months, one in three years while two others seemed to have been free of symptoms at one and five years except for some mucosal extrusion in the latter. The last patient developed carcinoma of the sigmoid and a Mikulicz suspension was performed incidental to resection.

5 *Suspension or Fixation of Cervix after Hysterectomy*—When a uterus is so long that its fundus can be lifted outside the abdomen, it is obvious that fixation of the fundus to the anterior abdominal wall would not lift the cervix as high as it could otherwise be lifted if a supracervical hysterectomy were done and the cervix suspended with the round ligaments or fixed to the anterior abdominal wall. For this reason a partial hysterectomy was performed in several cases and in others the hysterectomy had been previously done. It is probably justifiable to overlook the possibility of malignant degeneration of a retained cervix under these circumstances because of the greater support for the rectum to be secured by having the firm cervix as a support into which the encircling cul-de sac sutures can be passed, or to which the sigmoid can be anchored. There were three cases in which the cervix was fixed to the anterior abdominal wall. One is untraced, one died six years later following an operation for cancer of the splenic flexure with no notation in regard to the prolapse one recurred in one and a half years and had both an anterior and a posterior rectal fixation operation followed by excision of mucosa. She now has protrusion under some circumstances but gets along fairly well. The fourth case in this group also had a Mikulicz resection of a redundant sigmoid, and she is free of symptoms after seven years probably due chiefly to the Mikulicz fixation of the sigmoid.

6 *Mikulicz Resection of Redundant Sigmoid*—This procedure was carried out in four cases. One has been mentioned just above—a good result after seven years. One was resected because of a carcinoma of the sigmoid and is well at present after only six months. A third patient remains untraced. The fourth patient in this group now has some

De Lorme Operation.—The De Lorme operation was utilized in nine cases. Three of these had a repair of their sphincter also, one with a perineorrhaphy. One of them died a year later following an operation for mesenteric thrombosis, another after only five months is now well except for lack of sphincter action which was also absent prior to the

operation. Two others are well six years after operation. Another patient in whom a Tuttle posterior fixation was done at the same time, was well two years later. An old lady of 86 is having no symptoms a year after operation.

Miscellaneous Operations—In two cases *linear cauterization* was carried out, apparently under the misapprehension that the prolapse was only of the mucous membrane variety. Both patients seemed temporarily improved, probably due to inflammatory swelling, but the condition recurred in a short time.

CONCLUSIONS

Although some apparently good results occurred following most of these operations, it should be pointed out that by no means all could be followed up to present date. The striking fact is the high percentage of recurrence encountered with nearly every method. These recurrences were undoubtedly of the entire rectal wall in many instances, whereas in some it was only a laxness of the sphincter and of the mucosa which accounted for the patient's symptoms.

The De Lorme operation has been applied, for the most part, in more recent cases, so that the follow up period is not long, though it is up to date in all but one case. Any conclusions as to permanence of results are therefore not possible. The operation seems to accomplish, with perhaps a smaller element of risk from sepsis, what an excision of the prolapse would accomplish, and with less likelihood of stricture formation.

Excision of the prolapse, by compression ligature or by direct surgical amputation and suture, may well be the best single method of ensuring against recurrence, though its use in only two of our cases precludes any deductions on that basis. There is a limit to which a rectum will prolapse, even after many years, and if this protrusion is completely amputated it is hard to see how it can ever recur to any extent. There would, however, still remain the problem of the long overstretched atonic sphincter which never seems to regain its normal contractile power, and there remains the problem of the mucosal extrusion, both of which can be improved by plastic repair and excision of the mucosa.

The Moschcowitz operation, which was used in forty-three of the sixty cases, was undeniably a failure in a considerable number, yet it is based on a sound principle and probably should not be completely discarded but still used in conjunction with the De Lorme operation or with excision of the prolapse

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CURRENT PRACTICES IN THE SURGICAL TREATMENT OF ULCER

FRANCIS D MOORE M D *

In the past five years two events have occurred either one of which alone would have produced considerable alteration in our viewpoint of peptic ulcer. Taken in a mental way and for a therapeutic approach both medical and surgical. These occurrences have been on the one hand the lowering of the mortality in subtotal gastrectomy to 1 to 2 per cent and on the other the introduction of division of the vagus nerves as a therapy for intractable ulcer.

Subtotal gastrectomy for ulcer has reached a point of technical standardization accompanied by a very low hospital mortality rate. In duodenal ulcer the hospital mortality has fallen to the vicinity of 1 to 2 per cent for gastric ulcer the rate is even lower. The mortality rate in duodenal ulcer at the Massachusetts General Hospital arises chiefly from operation upon patients who are acutely bleeding a category which still poses many difficult and as yet unsolved problems.

Vagus resection for ulcer was introduced by Dragstedt in 1943. It was first carried out at the Massachusetts General Hospital in 1944. This operation has been cautiously applied to various types of ulcer in the ensuing three years and the patients studied carefully in an effort to determine the clinical results in a realistic fashion. This procedure for the first time enabled the surgeon to approach the ulcer problem at a level above that of organ removal. It has many theoretical and actual advantages. Yet its results looked at in the perspective of 1947 are not perfect and leave much to be desired.

It is the purpose of this article to discuss the present practice of the Surgical Service at the Massachusetts General Hospital in the light of these two new factors in ulcer surgery. Detailed bibliographic references will not be used; a general bibliography is appended. The author acknowledges his debt to the other members of the Surgical Service for the cumulative value of their experience.

In the past the statement was frequently made that the indications for surgery in the therapy of ulcer were perforation, hemorrhage, obstruction, the threat of malignancy, and intractability. The last named was regarded as the least important of the group and of

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escaped definition. It is possible now to define more accurately the meaning of the word "surgery" in these various situations and to add a new method for the treatment of intractability.

PERFORATION

Acute perforations are dealt with by simple closure of the ulcer, aspiration of liquid material from the peritoneal cavity and closure of the wound without drainage. The details of ulcer closure depend on the circumstances and, when necessary, a tab of omentum is used rather than anatomic suture.

No sulfonamide is used locally. Its local use is extremely toxic to the liver as high portal concentrations are obtained; nothing is accomplished thereby that cannot be done by means of systemic therapy. The peritoneal fluid is cultured. The stomach is placed on suction drainage by means of a Levin tube. The systemic care of the patient is determined by two factors: the burn-like character of the physiological disturbance and the nature of the infecting organism, if any.

Irritation of the peritoneum by hypertonic solution of low pH produces initially a cell-free transudate not unlike the edema of burns as regards its content of electrolyte, protein and water. Therapy should accordingly stress replacement of these essentials to avoid a shocklike state, both preoperative and postoperative. Large amounts of plasma are often necessary and a close observation of urine output is often helpful in evaluating the state of the patient.

The patient is placed on large but not massive doses of penicillin (up to 500,000 units per day) until the culture report is returned. Smear of the peritoneal fluid in early acute perforations is usually unavailing because of the presence of foreign material and lack of bacterial growth. If the culture indicates a heavy growth of gram-positive cocci which are sensitive to penicillin, the regimen is continued

untaken for at least five days, late exacerbations and re-accumulations of purulent exudate may thus be avoided.

Patients with late perforations (over twelve hours) who give evidence of beginning control of their process by lowering pulse, lessening abdominal spasm and good clinical appearance should be treated without surgery, using a strict Ochsner regimen, body fluid replacement and massive doses of penicillin and streptomycin. Operative interference in such situations may tip the balance of physiological

hope of success since their continued critical state is traceable to continued peritoneal soilage from an open perforation

The performance of subtotal gastrectomy or vagus resection in the face of acute perforation is to be condemned as a surgical *tour de force* which accomplishes nothing save the opening up of new areas to contamination and imposes a heavier weight on the already burdened adjustments of the patient's bodily economy

Occasionally the ulcer of a completely obstructed patient who is awaiting elective surgery will perforate. In these instances a feeding jejunostomy may be indicated as well as closure of the perforation

It is well to recall that in operating on a perforation one of the most important services performed for the patient by the surgeon is the painstaking removal by aspiration from the peritoneal cavity of all the contaminating duodenal or gastric contents which may act as the stimulus for the formation of secondary abscesses

HEMORRHAGE

The successful treatment of acute massive hemorrhage from ulcer depends upon the accurate determination of a diagnosis. That diagnosis may be stated as follows: "Is the patient (or is he not) going to cease bleeding spontaneously?" This question must be asked and an answer sought. If the patient is likely to cease bleeding spontaneously before a dangerous amount of blood has been lost, it is folly to operate on him during the acute imbalance produced by hemorrhage. It is far preferable to wait until a safe interval has elapsed and then carry out whatever surgery is indicated. On the other hand, if the patient is not going to cease bleeding himself, the longer one waits the greater the risk becomes.

Mechanisms which help the patient to stop bleeding consist chiefly of three: retraction of the bleeding vessel (in all cases of massive hemorrhage from ulcer the offending vessel is a small artery); clotting at the bleeding end; and cicatrization in the region of the ulcer. It is clear that in older people whose vascular elasticity has largely been lost as a result of peripheral arterial disease, the first of these mechanisms cannot operate. If there is any gross disorder of clotting present

in a heavily scarred duodenum, it is most unlikely that new formation of scar tissue will in any way operate to stop the present episode by the third mechanism.

For these reasons it has been the policy for some years at the Massachusetts General Hospital to consider individuals in the older age group—over 55 years of age—as patients who will probably not stop bleeding spontaneously. Early operation is advised. Younger patients have often been found to cease their bleeding spontaneously and for that reason conservative therapy with supportive measures has been carried out with reasonable success. There are exceptions in both categories however. In several cases emergency gastrectomies have become necessary in persons under 20 years of age because massive hemorrhage did not cease. In these patients upon opening the duodenum a side-wall opening in a bleeding artery has been found as the cause for the bleeding. In this type of lesion the artery is not severed it cannot therefore retract and will bleed from either end. In the older age group patients occasionally stop bleeding spontaneously and not infrequently the hope that this will occur has led physicians and surgeons to undue and fatal procrastination.

The details of conservative handling of the bleeding ulcer are beyond the scope of this discussion. Two points are worth emphasizing however. First early x ray carried out with the minimum of palpation is of the greatest importance. The diagnosis is often ques-

comes of
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and that

quantitative replacement of blood loss is of the greatest importance. One frequently hears the statement that inadequate blood replacement will maintain a low blood pressure diminish bleeding and is therefore advisable. This is not the case. The body will replenish lost blood volume from stores of extravascular fluid the blood pressure will gradually return to normal and the patient will find himself in the unhappy situation of having a normal blood volume with excessively low hematocrit and a low serum protein. Attempts to replenish thus by large amounts of whole blood transfusion then produce an intravascular plethora which in older patients may lead to cardiac

The technical details of surgical therapy for bleeding ulcer have been simplified in past years. The futility of any sort of vascular liga-

OBSTRUCTION

As in the treatment of hemorrhage, so in the treatment of obstruction the surgeon must determine for himself the subsidiary diagnosis, namely, "Is or is not the patient's obstruction going to subside spontaneously?" One commonly encounters three types of vomiting in the presence of peptic ulceration. The first might be referred to as reflex vomiting. It occurs as a manifestation of activity of the ulcer, is accompanied by little or no nutritional depletion and by x ray shows very little pyloric or duodenal obstruction. The second type of vomiting occurs in response to physiological obstruction at the outlet of the stomach. This has usually been spoken of as being due to "edema." One rarely sees edema of the folds in the neighborhood of an ulcer adequate to produce obstruction, and it is likely that this so-called "edema obstruction" is more frequently due to motor disorders in the region of the antrum, pylorus and duodenum, which result in the nonpassage of food into the duodenum and reverse peristalsis. By x ray the picture is often confusing and may give the semblance of a true obstruction. However, if the roentgenologist observes the patient under the fluoroscope over some period of time and takes films later throughout the day it often becomes apparent that when the pylorus does open it opens adequately. This observation is of the greatest importance in helping to arrive at the proper diagnosis. The third type of vomiting accompanies obstruction produced by long lasting ulceration in the region of the duodenum, which reduces the lumen of the duodenum to a small cicatrix. This often is spoken of as "pyloric obstruction" but should more properly be referred to as "duodenal obstruction."

The first type of obstruction, namely, that due to reflex vomiting should not be treated by surgery as it will frequently be intensified. If possible, it should be dealt with medically. In the second type of obstruction, that due to motor imbalance, surgery occasionally becomes necessary because of symptomatic difficulties, and should be considered under the category of intractability.

True obstruction caused by the formation of a cicatrized duodenum

or days gives one some information in this regard. If it is consistently over 300 cubic centimeters, a significant degree of obstruction exists. A simpler method consists in keeping an "oral balance chart" for the patient in which everything which goes in by mouth and everything which comes out by mouth (vomiting or tube) are calculated. The output is subtracted from the intake and if a negative figure results, obstruction is not only significant, but if left untended will interfere with nutrition.

The treatment of this type of cicatricial obstruction is subtotal gastrectomy. It is a strong contraindication to vagus resection, as the latter, by diminishing peristaltic activity proximal to the pylorus, will exaggerate the apparent obstruction.

In preparing an obstructed patient for subtotal gastrectomy, one should pay close attention to the patient's nutritional status, especially as evidenced by his presumptive nitrogen balance, serum protein chloride and total base. He may be assumed to be excreting 3 to 5 gm of nitrogen daily in his urine as a minimum. This is equivalent to approximately 25 to 35 gm of protein. Therefore, if this much protein nutrition is not being fed the patient by some route or other one may assume that he is in negative nitrogen balance. A low serum protein is evidence of nitrogen negativity, but nitrogen negativity may exist for some days or weeks before depletion is severe enough to lower the serum protein. Overhydration of the obstructed patient by colloid free solutions of sodium chloride or glucose is a mistake which produces excessive edema. The patient is b

either in the form of plasma, whole blood or concentrated albumin. The parenteral use of amino-acid mixtures has a place although its effectiveness in raising serum protein levels is dubious. Amino acids are a wasteful means of placing a patient in positive nitrogen balance.

Because of his gastrointestinal obstruction it is virtually impossible with methods now available to place him in caloric balance. By "caloric balance" is meant the provision of enough calories to meet his basal energy requirements.

will be deaminized, the nitrogen excreted as urea and the carbohydrate residue oxidized for energy. Under such conditions amino acids

is the determining factor. In this complicated subject it becomes apparent that the obstructed gastrointestinal statement can be made that man has not yet invented any way of replacing the intake of food by mouth. Therefore, the surgeon's problem is to give the patient a functioning upper intestinal tube at the earliest possible time. If the

patient is obstructed and in excessively poor nutritional status feeding jejunostomy is often a life-saving maneuver. If his nutritive status is not too depleted, however, it is far preferable to carry a short, intensive period of preparation not to exceed three days, then to go ahead with definitive surgery which will provide him an "internal jejunostomy" by which is meant an anastomosis between his stomach and his jejunum. If the duodenum is bound down by adhesions, which is often the case in the presence of obstruction, the first stage of a two stage gastrectomy is a perfect solution of the problem. By this is meant the initial transection of the stomach at the junction of its upper and second quarters, the performance of a satisfactory gastrojejunostomy, the removal of a sleeve of stomach, then turning in the remaining portion of stomach attached to the duodenum.

This procedure must in all cases be followed six to eight weeks by the removal of the retained antral segment. The reasons for this will be made clear below.

Occasionally a patient with almost complete gastric obstruction demonstrates surprisingly little evidence of nutritional disorder. It is found to be the case when the obstruction has not been present long and the patient has not been given large amounts of colloid fluid by vein. In such situations, again, the best procedure is a short intensive period of preparation followed by a subtotal gastrectomy in one or two stages.

The performance of a posterior gastroenterostomy and concomitant subdiaphragmatic vagus resection has been recommended as a treatment for obstruction. At the Massachusetts General Hospital, this operation has been carried out in a few cases. However, we feel that patients with any form of a gastrojejunostomy are exceptionally vulnerable to subsequent jejunal ulceration, and that this operation is not justified until more experience with the late effects of vagus resection has given us some idea of the ultimate fate of these patients. For that reason we do not carry out this "double procedure" in the obstructed patient, except under extraordinary circumstances.

THE THREAT OF MALIGNANCY

In past years there has been much bewilderment over what to do with a patient with a gastric ulcer. On one end of the scale was the patient with no hydrochloric acid after histamine, a large lesion with a shelllike border, a palpable mass, in short, with obvious malignancy. In this patient, of course, removal was advised. At the other end of the scale was the patient with a long history of ulcer, previous duodenal ulcer, high acidity, multiple ulcers in the stomach, no free defect, in short, all the criteria for benignancy. In this patient the operation by medical means was often carried out over a period of years. I

ever, between the two ends of this spectrum lay a broad band of merging and often confusing clinical situations, many of which were thought to be benign but turned out to be malignant.

Recent reports from several clinics have indicated that 15 to 25 per cent of diagnoses made in the presence of gastric ulcer are wrong. This means that approximately one out of every four gastric ulcers called benign is actually malignant. These diagnoses are based on all the present methods known including gastroscopy. The platitude should also be added that the pathologist with the stomach in his hand cannot tell whether the ulcer is benign or malignant, and, therefore, how can the physician who looks at the patient from the outside or the surgeon who looks at the stomach make a histologic diagnosis?

It has, therefore, become apparent that the therapy of all lesions proximal to the pylorus should be basically surgical. By this is not meant that as soon as a gastric ulcer is diagnosed, the patient is immediately taken to the operating room. Rather, it is meant that when an ulcer is found proximal to the pylorus, the patient's therapy is carried out with the idea in mind that surgery will be carried out as soon as practical. All observations that can be made concerning the ulcer should be made, for in the occasional case the criteria for benignancy may be so overwhelming that conservative therapy may be used. The occurrence of healing in six weeks and its rigid maintenance must, however, be set down as prerequisites for the patient's avoiding a gastrectomy.

In the vast majority of cases, however, gastrectomy should be carried out. The patient who has had a gastrectomy carried out for an allegedly benign ulcer and is found to have a small area of carcinoma, has had cancer surgery carried out under the most favorable circumstances known to us. There is no point in trying to satisfy some

lesions, a somewhat more protracted period of medical therapy is justified in an effort to determine whether or not the lesion is benign. If the ulcer does not heal, the ulcer should be condemned. If the ulcer heals, a vagus resection one is even less certain. If the lesion is malignant. Not in the case of a benign ulceration. This ulceration may heal following vagus resection and give the patient a false sense of security. The recommendation has been made that vagus resection be used as a "therapeutic test" for gastric ulcer, the idea being that if the ulcer heals after a vagus resection the lesion must be benign. If it does not heal it is malignant and should be

removed. What has been said above would seem adequate refutation of this argument. One may also agree that the patient is hardly to be blamed if after one major operation to heal his gastric ulcer he refuses further surgery when told that his lack of response indicates that his stomach should have been taken out in the first place.

As indicated in the foregoing section most of the mortality from duodenal ulcer surgery comes either from bleeding or difficulties with the duodenal stump. Neither of these difficulties is present in most cases of gastric ulcer. For that reason the mortality of subtotal gastrectomy in gastric ulcer is very low. The incidence of late jejunal ulceration is also significantly lower than it is after subtotal gastrectomy for duodenal ulcer. These two considerations may well be taken into account when decisions are being made for patients with gastric ulcer.

INTRACTABILITY

It has always been difficult to define the intractable ulcer. One of the most appealing definitions is that of an ulcer which is no longer tolerated by the patient; the patient has lost patience with his symptoms and with his therapy. This, however, may be too narrow a definition as poor medical therapy may result in loss of patience much more rapidly than adequate therapy. The economic habilitation of the patient must be taken into account. The presence of repeated hemorrhages in the past also enters into the equation. The age of the patient is a factor since a patient in the older age group who is entering the last few decades of his life will tolerate surgery progressively less well. F

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quest for surgery is the increasing restlessness of the patient under medical therapy. It has become generally known to the public that surgical therapy for peptic ulcer is neither as radical nor as dangerous as it used to be. Recent news and is to be deplored. Many ulcer symptom. When one of either subtotal gastric resection clear that these patients should initially have a thorough trial of medical therapy before taking the surgical step.

Vagus Resection—It is in the treatment of the intractable but unobstructed and not acutely bleeding patient that vagus resection will find usefulness. The experience with this operation at the Massachusetts General Hospital in the last three years now totals approximately ninety patients. Of these patients sixty-five have had duodenal ulcer and have had vagus resection carried out without other maneuvers to the stomach. Two additional patients have required post

operative gastroenterostomies because of physiologic obstruction following vagus resection, and two other patients have had gastroenterostomies carried out before or with their vagus resection. The remaining twenty five patients had vagus resection carried out for jejunal ulceration following either subtotal gastrectomy or posterior gastroenterostomy

All these patients have had thorough vagus resections carried out through the chest with careful dissection of the nerve trunks. Most of them have had the dissection carried down through the diaphragm to the point of decussation of the nerves on the gastric wall. This is the most thorough vagus removal reported in the literature. It should be stressed again that this is a series of vagus resected patients who have not had other forms of surgery carried out, at the time of vagotomy.

To date, results of vagus resection in these patients are rather disappointing. Whereas one might hope that vagus resection would produce protracted healing of the ulcer and a long period of freedom from symptoms, one finds instead that it is followed by a recurrence rate which, at the present time, does not differ significantly from that following subtotal gastrectomy. Vagus resection, of course, has a lower mortality than subtotal gastrectomy. It is possible to carry it out through the chest in patients who have had multiple abdominal

show end results which are as good or better than subtotal gastrectomy in order to be able to replace the latter completely. At the present writing vagus resection is in an interim state which is very difficult to evaluate. It is almost impossible to lay down any precise rules. However, the following statements seem justified.

1 For the treatment of jejunal ulcer vagus resection achieves great usefulness at the present time. Its future will rest, regardless of its convenience, on the long term well being of the patient.

2 In the patient with a nonobstructed painful, intractable duodenal ulcer which has come on early in life and produces its worst symptoms during periods of environmental stress, vagus resection appears to achieve its maximal usefulness. We have had fewer difficulties in this group than in any other.

3 If one is going to embark on vagus resection as a therapy for ulcer, it is important to do so carefully, select the patients according to a predetermined scheme, follow them carefully and do enough of the operations to acquire familiarity with the postoperative care. It is the isolated occasional vagus resection done with inadequate experience that has produced an occasional fatality.

Most of the patients who have had vagus resection carried out in

this hospital are still well and may remain so. The present incidence of unsatisfactory results due either to recurrence or the presence of bothersome side effects such as diarrhea and a sense of fullness totals approximately 15 per cent of the cases.

It is apparent that vagus resection is not a simple solution to all ulcer problems but is instead a new operation which has distinctly unusual features which has usefulness in certain cases and which will require further time for complete evaluation. It has many advantages not shared by subtotal gastrectomy. For a more thorough discussion of this subject the reader is referred to the many articles which have been published on vagus operations in recent years.

Subtotal Gastrectomy—A discussion of the treatment of intractability is an appropriate place to bring up some other features of subtotal gastrectomy which have not previously been mentioned in this article.

1 Recurrent Jejunal Ulcer—The incidence of recurrent jejunal ulcer after subtotal gastrectomy for intractable duodenal ulcer varies from 2 to 12 per cent. It is now becoming apparent that when subtotal gastrectomy is carried out for repeated massive hemorrhage especially if the massive hemorrhage is unaccompanied by pain the incidence of recurrent bleeding after subtotal gastrectomy is much higher than the occurrence of demonstrable jejunal ulcer. Some estimates run as high as 35 per cent. This situation is disquieting and again points up the inadequacy of our present technique. Vagus resection for recurrent massive silent bleeding carried out in a quiet interim may offer a better solution. Few patients who have had vagotomy for this indication have been followed long enough to give us the answer to this question.

Recurrent ulcer after subtotal gastrectomy has always been a perplexing problem. Re-resection of the proximal stomach has nearly always been disappointing. One must consider carefully whether or not any antral tissues remain in place (see below). Vagus resection is the best means of handling this situation that we have available at the present time.

2 Other Postoperative Effects Following Subtotal Gastrectomy—Until recently we have had little statistical idea of other side effects following gastrectomy. It has been known that patients often suffer prolonged nutritional inadequacy that others have peculiar symptoms after eating and that a third group have peculiarly specific food intolerances. It is now possible to say that all these complications grouped together may total from 15 to 25 per cent of patients who have had subtotal gastrectomy. The symptoms may be transient but in occasional cases are life-long.

The occurrence of peculiar symptoms after eating, symptoms of weakness, dizziness, sweating, palpitation and vertigo have been re-

operative gastroenterostomies because of physiologic obstruction following vagus resection, and two other patients have had gastroenterostomies carried out before or with their vagus resection. The remaining twenty five patients had vagus resection carried out for jejunal ulceration following either subtotal gastrectomy or posterior gastroenterostomy.

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of the stomach. They will not, however, completely obviate malfunction of the stoma and it is important to remember that they produce another opening in the gastrointestinal tract from which poten-

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will often help to establish whether or not the obstruction is "physiologic" or is due to organic difficulties. If the latter, the barium will usually be seen to enter the jejunal loop a short distance and stop an inch or so from the stoma. The cautious use of cholinergic drugs such as mecholyl or urecholine may be helpful in solving some of these problems in the future. In general conservative therapy employing the feeding jejunostomy if the patient cannot take food satisfactorily, is successful in the majority of cases.

4 *The "Antral Syndrome"*—As subtotal gastrectomy is performed more and more commonly throughout the country, a certain group of cases is being seen in the larger hospital centers which justifies a nomenclature of its own. This consists of patients who have had the proximal segment of the stomach removed and anastomosis carried out, yet who have never had the antrum and pylorus taken out. They have had the first stage of a two stage gastrectomy carried out, but through the negligence of the surgeon or the noncooperation of the patient they have never had the second stage completed. In connection with this, one should observe that a two stage gastrectomy should never be undertaken in a patient who has not had the matter discussed with him. He should also be told that the second stage is as essential to the first stage as though it were part of the same operation.

In the face of the above situation, namely, retained antral mucous membrane after subtotal gastrectomy a series of events takes place that is of the greatest interest. Jejunal ulceration forms in the great majority of the cases. It often occurs within eight weeks of operation. It has been known to occur even before the patient has left the hospital. It is of a peculiarly intractable type and will not respond to atropine, alkali or any other form of medical therapy. The patient has just had a subtotal gastrectomy carried out and his physician and surgeon are in despair as to the nature of the difficulty and its treatment. The patient's symptoms are so intractable that he is frequently accused of being psychoneurotic.

A case history may be illustrative of this phenomenon.

Mr B S (M G H No 343703), a 51 year old male, was admitted to the Massachusetts General Hospital with a story of ulcer symptoms dating back twenty five years. He had experienced both perforation and hemorrhage, and four years prior to entry a partial gastrectomy had been performed. Within eight weeks of operation symptoms recurred and twice more his stomach was re-resected proximally. His pain became more and more severe in the back and six months

ferred to as the "dumping syndrome." This name has been coined because of the repeated observation that in these patients barium seems to "dump" into the efferent loop of jejunum with great rapidity. Unfortunately those who gave the syndrome its name did not observe asymptomatic subtotal gastrectomized patients under the fluoroscope in enough instances to become aware of the fact that following subtotal gastrectomy the normal state of affairs consists of a very rapid "dumping" into the jejunum. It therefore seems highly unlikely that this is the mechanism and it is an unfortunate name. Changes in glucose absorption have also been blamed for the syndrome. It has been the common observation that after subtotal gastrectomy hyperglycemic levels are attained much more rapidly after eating than they are in the normal patient. This produces an excess secretion of insulin with a resultant secondary fall to hypoglycemic levels which might possibly produce symptoms. The only difficulty with this theory is that the postprandial symptoms of the so called dumping syndrome occur within a few minutes of eating always within a half hour whereas the hypoglycemic phase of the curve does not occur for two or three hours and frequently does not reach very low levels.

The dumping syndrome cannot be abolished by section of the vagus nerves. It is therefore possible to draw the conclusion that the reflex end of this arc is not carried upward over the vagi. The dumping syndrome cannot be abolished by giving large doses of atropine. We may therefore conclude that the efferent end of the reflex arc is not cholinergic. Beyond these various localizing evidences we can say little about the nature of this interesting disorder. A careful physician may often help the patient greatly by questioning him as to what types of foods produce the symptom complex and by having the patient learn to avoid them. The avoidance of rapid eating, eating a very small meal in the morning, taking protein before taking any carbohydrate and other therapies have been helpful.

3. *Technic of Subtotal Gastrectomy* *Malfunctioning Stomas*—The intimate surgical technic of subtotal gastrectomy is beyond the scope of this paper. One should avoid taking a categorical stand that this or that type of anastomosis is "always" necessary. It has been found best over a period of years to carry out the type of anastomosis which lies naturally and without tension in the patient's abdomen. This may sometimes be in front of or behind the colon. It may sometimes be anti- or iso-peristaltic. No single anastomosis will suffice for all the patient's needs. The only statement that seems justified is that the shorter jejunal loops are probably more satisfactory because high jejunum is slightly less vulnerable to gastric secretion than lower jejunum. Indwelling jejunostomies have been worked out and perfected in this hospital by Dr. Allen and his associates. They are often helpful in feeding the patient or decompressing the proximal segment.

of the stomach. They will not, however, completely obviate malfunction of the stoma and it is important to remember that they produce another opening in the gastrointestinal tract from which potential leakage and sepsis may occur.

The malfunctioning gastrectomy stoma is much less frequently seen than formerly. However, it still does occur. A small swallow of barium will often help to establish whether or not the obstruction is "physiologic" or is due to organic difficulties. If the latter, the barium will usually be seen to enter the jejunal loop a short distance and stop an inch or so from the stoma. The cautious use of cholinergic drugs such as mecholyl or urecholine may be helpful in solving some of these problems in the future. In general, conservative therapy employing the feeding jejunostomy if the patient cannot take food satisfactorily, is successful in the majority of cases.

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prior to entry a laminectomy and fusion were carried out with the diagnosis of ruptured intervertebral disk

His pain became progressively worse food and alkali relief became progressively more transient and he was labeled a hopeless psychoneurotic. X rays had shown a jejunal ulcer at various times on admission a large jejunal ulcer was present

One week after admission a small right sided abdominal incision was made and a 2 inch segment of antrum removed together with the pylorus and a strip of duodenum

His pain was relieved the jejunal ulcer healed. The patient has regained his weight and strength and is now at work and essentially well. It should be emphasized that at operation nothing was done to the proximal cuff of gastric tissue anastomosed to the jejunum.

This diagnosis of "retained antrum" should be suspected in any jejunal ulcer following subtotal gastrectomy. The physiologic background has been discussed elsewhere. In our experience such ulcers will not respond to vagus nerve resection the removal of the antral segment is mandatory.

SUMMARY

1 Present day practices of the Surgical Services of the Massachusetts General Hospital relative to the surgical therapy of ulcer are briefly described

2 Subtotal gastrectomy and vagus resection are the chief procedures available

3 Vagus resection is too new to evaluate finally. Failures and crippling side effects have been encountered and the operation is not recommended for routine application

4 All cases of jejunal ulcer following subtotal gastrectomy should be critically reviewed for the question of a retained antrum before other therapy is undertaken

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THE ANASTOMOSIS OF SEVERED ARTERIES BY A NONSUTURE METHOD

F. A. SIMONE M.D.*

The frequency with which gangrene occurs in limbs when the main artery is interrupted acutely has been a challenge to surgeons for nearly two centuries and has led some to devise methods for re-establishing continuity in severed arteries by simple means. Payr in 1900¹ recommended a prosthesis of magnesium chosen as an absorbable metal over which the ends of severed blood vessels could be ligated intima to intima. The method was tested experimentally

mended by Tuffier⁴ but interestingly enough no mention was made of Payr's method. "Gas cysts" had been described by Hopfner in unsuccessful experimental cases undoubtedly a tissue reaction to magnesium (Walter⁵) and these may have discouraged further trial of the method.

In 1942 Blakemore, Lord and Stefko⁶ reported their technic for nonsuture anastomosis of severed arteries and suggested that it could be applied to arterial wounds incurred in combat. The prosthetic tubes were made of vitallium and were made available overseas through the Office of The Surgeon General. From August 1944 until the close of the war in the Mediterranean Theater of Operations the technic was used in thirteen cases (Table 1). Two of the patients were operated upon in base hospitals (21st General Hospital and 23rd General Hospital) eleven were operated upon in forward hospitals (94th Evacuation Hospital and 8th Evacuation Hospital) †

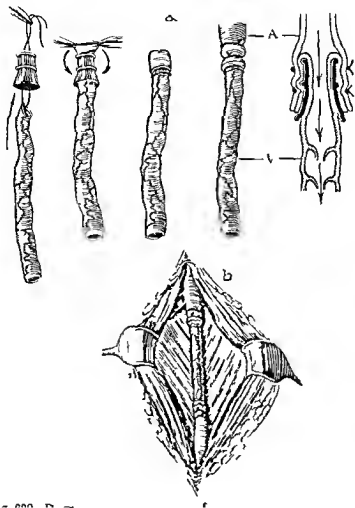
SELECTION OF CASES

Since the supply of vitallium tubes was limited and since the method under battle conditions was considered purely experimental patients were chosen who had severe wounds of critical vessels such as the popliteal artery and in whom there was good clinical evidence that the limb would probably not survive i. e. the cold pulseless often anesthetic and motionless extremity. In two patients when no vital

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† The writer is indebted to the commanding officers and staffs of these installations for the privilege of studying the cases and of operating upon nine of them personally.

hum tubes were available stainless steel prostheses were used which had been made by a local ordnance company with the vitallium tubes as models



artery A represents artery v represents vein. In b the completed anastomosis of a severed popliteal artery is shown diagrammatically. Note that collateral vessels are spared.

TECHNIC

The operative technique was essentially that described by Blakemore Lord and Stefko⁷ and is shown diagrammatically in Figure 329. It is

TABLE 1.—DATA PERTAINING TO THIRTEEN PATIENTS IN WHOM

Case No	Age	Artery	Muscle	Location of Arterial Wound	Fracture	Shock	Lag Between Wounding and Completion of Anastomosis (Hours)	Lag Between Interruption of Circulation and Completion of Anastomosis (Hours)
1 (J W B)	23	Axillary right	Shell fragment	Midaxilla.	None	Moderately severe	12	12
2 (F L S)	27	Femoral left	Machine gun bullet	7.8 cm below the groin.	None	None until operation	19	19
3 (L H P)	22	Femoral left	Shell fragments	In adductor canal.	None	Moderately severe	14	14
4 (L C A.)	25	Femoral right	Grenade fragments	In adductor canal 4 cm distal to origin of profunda femoris artery	None	None	38	85
5 (R W B)	21	Femoral right	Machine gun bullet	In adductor canal.	None	Moderately severe	13.5	13.5
6 (S G V)	26	Popliteal right	Bomb fragment	At bifurcation of the artery into anterior and posterior tibial arteries. A 3 cm. length of artery avulsed by the missile.	None	Moderately severe	57	11
7 (J H B)	23	Popliteal left	Shell fragment	High in popliteal space just distal to adductor tendon.	None	Severe	210	8.5
8 (J H M)	22	Popliteal left	Rifle ball	Midpopliteal space. A 3-cm gap between ends of arteries.	Severe	Severe	49.5	49.5
9 (J V K.)	29	Popliteal right	Shell fragments	High in the popliteal space just beyond adductor tendon.	None	None	14	14
10 (C E H)	20	Popliteal left	Shell fragments	In mid-popliteal space	None	None	25	25
11 (D E B)	20	Popliteal left	Shell fragments	Artery avulsed from its junction with anterior and posterior tibial arteries	Severe	None	14	14
12 (H B)	18	Popliteal left	Shell fragments	Artery divided in popliteal space with a 4 cm. defect	Severe	None	19	19
13 (T R W.)	21	Popliteal right	Shell fragments	Popliteal artery lacerated in midpopliteal space for two-thirds of its circumference	None	Moderately severe	15.5	2

Duration of Operation (Hours)	Sympathectomy	Sympathetic Procaine Block	Heparin	Result	Reason for Amputation	Comments
2 5	Not done Brachial plexus injury	Not done.	Not used.	Complete survival of limb		Cold pulseless hand and forearm before operation. Hand warm immediately after anastomosis. Radial pulse palpable 2 5 days later.
1 5	Done 11 hours after anastomosis	Done immediately after anastomosis.	Not used	Complete survival of limb		Posterior tibial artery palpable 3 days after operation
4	Done just before the anastomosis	Not done	600 mg per-day intravenously	Supracondylar amputation of leg	Wet gangrene	Clostridial myositis was suspected but not found
	Done just before the anastomosis	Not done	Not used	Complete survival of limb		Cold pulseless foot before anastomosis. Warm foot immediately afterward. Two days after anastomosis a toes on injured side were warmer than those on intact side.
5	Not done	Done twice	Used in P.T. for 2 months subcutaneously	Complete survival of limb		Flapotomy done to relieve tension in swollen muscles of calf
7	Done just before anastomosis	Not done	Not used	Complete survival of limb		No demonstrable abnormality of circulation after wound closed. A sudden secondary hemorrhage occurred from popliteal artery 5 hours after wounding. Leg then became cold, pulseless and swollen.
1 5	Done 2 days after anastomosis	Done twice	Not used	Amputation through midleg	Wet gangrene	Acute interruption of circulation occurred 9 days after wounding because of secondary hemorrhage. Anastomosis functioned until hemorrhage occurred from erosion of popliteal artery through artery 11 days later.
2 5	Not done	Done twice but not after anastomosis.	600 mg per day intravenously	Supracondylar amputation of leg.	Wet gangrene	Anastomosis done after ligation of the severed artery (14 5 hours after wounding) was obviously resulting in gangrene.
3	Delayed 12 hours after anastomosis	Done once	600 mg per day intravenously	Supracondylar amputation of leg	Wet gangrene.	At amputation, thrombosis was found in the vein segment and in the popliteal artery both above and below the anastomosis.
4	Done just before the anastomosis.	Not done.	600 mg per day intravenously	Amputation through midleg below knee.	Dry gangrene of toes retractable pain in foot.	At amputation, the calf muscles had good circulation.
3	Done just before the anastomosis.	Not done	600 mg. per day intravenously	Supracondylar amputation of leg	Wet gangrene	Progress was satisfactory (toe warm) until hemorrhage occurred from vein segment
2	Done just before the anastomosis.	Not done.	600 mg per day intravenously	Midthigh amputation.	Clostridial myositis in spite of penicillin.	Thrombosis occurred in vein segment.
3	Done immediately after the anastomosis.	Not done.	Not used.	Probable loss of toes only	Dry gangrene	Circulation was grossly normal until acute interruption occurred secondary to massive hemorrhage from popliteal artery while patient was being prepared for debridement 14 hours after wounding.

important to place the vein segment in such a manner that the valves will not obstruct the flow of blood through it, a precaution already noted in the text of Case 7.

Tubes of appropriate size must be chosen. When too large for the artery, the edge of the tube may cut through the wall of the artery and lead to secondary hemorrhage (cf Case 7). The photograph of a completed anastomosis is shown in Figure 330.



Vein seg-
ment (Case
7) U. S. Army

Medical Museum

In all thirteen patients the concomitant vein was ligated. This was not done in the belief that it would improve the available circulation but because the veins were irreparably damaged along with the

the first hospital installation with 25 000 units intramuscularly and repeating the injections at three hour intervals Tetanus toxoid was administered routinely Blood and plasma were used for resuscitation By and large less blood was used than was actually needed (Table 2)

TABLE 2

DATA EMPHASIZING THE NEED OF BLOOD IN PATIENTS WITH WOUNDS OF THE ARTERIES

Case No	Replacement Therapy in Immediate and Postoperative Period (expressed as cubic centimeters)		Hematocrit (per cent)	Plasma Protein (grams per 100 cc.)	Hours after Wounding
	Plasma	Blood			
1	0	3000	41	6.2	24
2	2000	500	37.2	6.2	40 (approx)
3	1150	1250	73.7	6.1	45.5
4	250	500			
5	1250	2500	38.5	6.4	29
6			30	7.1	65
7		2500	29	5.4	210
8	750	2000	29.4	6.2	60
9	1000	2000	32.5	5.5	73
10	250	1500	26.5	5.3	70
11	500	2500	24.8	5.4	61
12	750	2000	31.0	6.0	32
13	500	1500	40	5.8	33

Heparin was used when available In one of the patients subcutaneous heparin in Pitkin's menstruum was used In the remainder heparin was used intravenously at the constant rate of 600 mg per 24 hours

RESULTS

The results obtained in the thirteen cases are recorded in Table 3

Axillary Artery—This technique of nonsuture anastomosis was applied to the severed axillary artery only once In this patient the circulation in the fingers was critical The hand was described as "cold and motionless" Promptly after the anastomosis although no pulsations were felt in the brachial and radial arteries the hand was warm of good color and the capillary circulation in it was normal Three days after operation the radial pulse was easily palpable This is a better result than was expected if the axillary artery had been ligated In a group of twenty six cases (Simcone⁴) in which the axillary artery was ligated because of wounds and no anastomosis was done gangrene involving a part of the limb necessitated amputation in eight (31 per cent) In the larger group of seventy four cases collected by DeBakey

and Simeone⁹ in which the artery was interrupted, thirty two (43.2 per cent) had to have amputation of part of the limb. Such data, com-

Femoral Artery—Amputation through the thigh was necessary in only one of four patients in whom nonsuture anastomosis of the femoral artery was done in the adductor canal. In fifty unselected cases of wounds of the superficial femoral artery (below the common femoral) observed in the same theater of operations and under comparable conditions (Simeone⁹) amputation was necessary in twenty five.

TABLE 3

RESULTS OF NONSUTURE ANASTOMOSIS OF ARTERIES IN THIRTEEN CASES

Artery	Results				
	No Amputation	Amputation of Toes	Amputation through Low Leg	Amputation through Thigh	Total
Axillary	1	—	—	—	1
Femoral	3	—	—	1	4
Popliteal	1	1	2	4	8
Total	5	1	2	5	13

In a larger group of war wounds of the superficial femoral artery (DeBakey and Simeone⁹) amputation had to be done in 54.8 per cent (ninety seven out of 177 cases). The 25 per cent amputation rate in the four patients who had nonsuture anastomosis of the severed vessels is of no statistical significance. Nevertheless the clinical impression was gained that these patients had better circulation in the extremity than was expected if the vessel had been simply ligated.

Popliteal Artery.—The entire limb was spared in only one of the eight patients in whom nonsuture anastomosis of the popliteal artery was done. Seven had to have amputations: four through the thigh, two through the leg below the knee, and in one patient (Case 13) probably only the toes were lost. These results are poor. They are to be compared with thirty eight patients observed personally (Simeone⁹), in whom the popliteal artery was simply ligated. Of these nine had complete survival of the limb (24 per cent), six had amputations below the knee (16 per cent) and twenty three required amputation through the thigh (60 per cent). Among five hundred and two cases collected by DeBakey and Simeone⁹ one hundred thirty eight resulted in survival of the limb (27.5 per cent). It would appear

then that in the case of the popliteal artery the results of the injury were not improved by nonsuture anastomosis of the severed artery.

Two points however, require emphasis. In the first place, while done by capable surgeons these operations involved a new technic and one could expect better results as greater experience was gained. The poor results in Cases 7 and 11 for instance are attributable to secondary hemorrhage from erosion of the proximal tube through the artery in the former, and hemorrhage from a tiny branch of the transplanted vein segment in the latter. In the second place, the operations were done in cases in which loss of substance was extensive and in which as a selected group the prognosis for limb survival would not have been as good as 27.5 per cent.*

COMMENT

The resuscitation of patients with wounds of the arteries was conducted according to the principles used in battle casualties in general (Beecher¹⁰). It is of special interest and of considerable clinical importance to observe that the estimates of blood loss in the patients with arterial injuries were obviously too low (Table 2). It will be seen from Table 2 that hematocrit concentrations are low even when large volumes of blood are used for replacement as in Case 11. It is of little avail to reestablish arterial channels without assuring a blood volume sufficient to fill them adequately. Oxygen therapy, to improve the oxygen content of the blood and thereby raise the oxygen tension of capillary blood in relatively ischemic tissue was not used in these patients. Heparin was administered when available. As can be seen from Table 1 however a beneficial effect from its use was not demonstrable. It should be used nevertheless, when contraindications do not exist for in specific instances the prevention of thrombosis may make the difference between success and failure. Penicillin was used to treat impending or actual infection and sympathectomy was done in the majority of cases to aid the collateral circulation.

Other methods of nonsuture anastomosis were tried late in World War II. Defects were bridged with glass tubes also an old method or with tubes made of plastic material probably vinyl resins. Detailed data concerning these cases have not been recorded. The nonsuture anastomosis in the thirteen cases in this paper is that described by Blakemore, Lord and Steflo.⁷ Long follow ups are not yet available but the cases are presented because they are adequately documented and at least the immediate results up to the time they were evacuated to the Zone of the Interior can be given.

Amputation of a part of the extremity was necessary in eight of the

* Survival of the limb is not expected when severance of the popliteal artery is associated with fracture through the knee joint. Three of the seven patients who did develop gangrene had severe fractures.

thirteen patients. Among 753 patients with wounds of comparable arteries (DeBakey and Simeone 1946) amputation was necessary in 493 or in 65 per cent of the group. The results following nonsuture anastomosis evidently were not better than the over all results following other methods of treatment of war wounds of the arteries. The patients in whom the technique was tried however had particularly severe wounds.* The results would certainly not have been better and possibly not as good by other methods of treatment. In the cases which did not come to amputation the circulation of the extremity



Fig. 331.—Arteriogram in Case 6 demonstrating well developed collateral circulation. Result may not have been as good had it been necessary to sacrifice the collateral vessels (Case reported by Harbison 1945 courtesy of Surgery Gynecology and Obstetrics)

as evaluated clinically was better than could be expected if the arteries had been ligated.

Two complications occurred both of them consisting of postoperative hemorrhage. In the first (Case 7) the bleeding resulted from erosion of the vitalium prosthesis through the wall of the artery. In retrospect, the vitalium tube was too large for the artery and the

* See previous footnote.

thrombosis had already taken place peripherally. In both these cases the clinical appearance of the feet had suggested fairly good results with possible loss of the toes in Case 7 and possible complete survival of the limb in Case 11.

In the employment of the technic of nonsuture anastomosis, there is danger of sacrificing important collateral arteries in order to obtain sufficient length for the anastomosis. Since eventual thrombosis of the



Fig 332—Arteriogram demonstrating patency of anastomosis in Case 5 twenty five days after operation. A Before injection of diodrast into common femoral artery. B immediately after injection. (Museum and Medical Arts Service Neg No CA 45-864 and CA 45-864 A. U. S. Army Medical Museum) (B is reproduced from *Annals of Surgery*, 1946 courtesy of J. B. Lippincott Co.)

anastomosis is expected and the circulation of the limb below the wound will depend upon an adequate collateral circulation, it is well to spare collateral vessels and to desist from attempts at establishing continuity by the nonsuture method if completion of the union depends upon sacrificing important collateral vessels. The result in Case 6, for example, might not have been as good had it been necessary to sacrifice the collaterals demonstrated in the arteriogram (Fig 331). The

function of the anastomosis is to tide the extremity over while the collateral circulation is developing. If thrombosis of the anastomosis occurs before a collateral circulation is established, survival of the limb is unlikely. Patency of the anastomosis may continue for quite some time, however, if not permanently. In Case 5 (Fig. 332), patency was demonstrated twenty five days after operation.

The method of nonsuture anastomosis of arteries is not the answer to the high incidence of loss of limb in war wounds of the arteries. For one thing, especially in World War II, the wounds often involved extensive destruction of tissue so that amputation was indicated primarily because of extensive loss of tissue in two-thirds of the cases that had to have amputation (DeBakey and Simeone⁹). For another, the patients were seen too late after interruption of the arterial circulation (Table 1). When more than six hours have elapsed from the time of complete interruption of arterial circulation, irreversible changes in the muscles and intravascular thrombosis can be expected to have taken place. Attempts at preventing thrombosis by the immediate administration of heparin and of delaying irreversible changes by means of refrigeration are hazardous and impractical in the field.

It is believed, nevertheless, that establishment of the anastomosis resulted in better circulation than could have been expected otherwise in five of the thirteen cases listed in Table 1 (Cases 1, 2, 4, 5 and 6). In three of the remaining eight cases, the feasibility of amputations at levels below the knee might be attributed to the somewhat better circulation as a result of the anastomoses (Cases 7, 10 and 13). As a matter of fact the technic may meet with greater success in civilian than in military practice for traumatic cases can be treated sooner in civilian practice and immediate anastomosis can be made when major arteries must be sacrificed in the operations for malignant disease. In the treatment of portal hypertension Blakemore and Lord¹¹ have used the technic for establishing veno-venous shunts.

SUMMARY

1 The results in thirteen patients with war wounds of major arteries treated by a method of nonsuture anastomosis have been presented (Tables 1 and 3).

2 Factors which influence the outcome of the treatment are indicated in Table 1 and the importance of blood replacement has been emphasized (Table 2).

3 At least two of the failures after anastomosis of the popliteal artery resulted from postoperative hemorrhage, the result of technical error.

vascular surgery among civilians than among battle casualties because of the shorter time lag to surgery and the generally less extensive nature of the wounds among the former

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tions, studied 2413 patients appearing in the outpatient department of the Presbyterian Hospital in New York City for various reasons, but without any gastric symptoms. They discovered three malignant lesions of the stomach. Routine gastric analyses of all patients entering outpatient clinics with further investigations of those who show achlorhydria has also been proposed as a method of discovering early cancer, this method is open to many objections.

DIAGNOSIS

Of the various methods of diagnoses that are available, the most important are (1) a careful history, (2) x ray examination, (3) gastroscopy, and (4) examination of the gastric contents for malignant cells. The symptoms are often minimal, consisting of indefinite epigastric distress, slight nausea, or eructations. Persistent symptoms of this nature require investigation with x ray. A negative examination must be repeated in three weeks if symptoms continue.

The x ray remains the most important single diagnostic measure because of its simplicity and accuracy. If an ulcerating lesion of an indeterminate nature is discovered, gastroscopy and microscopic examination of the gastric contents are essential. The observation by gastro

Papanicolaou⁵ has emphasized the value of microscopic examination of the gastric sediment. Fresh centrifuged specimens of fasting contents precipitated by alcohol and stained by this method, will give a diagnosis with a high percentage of accuracy. The smear is of the utmost importance when it is positive, and less significant when it is negative. In a series of forty seven smears recently made in this hospital the preoperative diagnosis of cancer had been made in fourteen out of the twenty two lesions which were proved malignant by pathological examination. Of twenty five resected specimens proved benign by the pathologist, twenty four had been diagnosed correctly. We have recently had a case in which the x ray, gastroscope and clinical findings all indicated benign ulcer, but in which the cytologic diagnosis of cancer was confirmed by the final pathological examination of the resected specimen.⁶

It is much more important to diagnose the presence of a gastric lesion than to determine its exact nature. There will be a large group of cases in which the differential diagnosis of benign ulcer and cancer will be impossible. There is often a dilatory attitude adopted towards these lesions that is absolutely unjustified, for the number of cancers that masquerade as benign gastric ulcers⁷ is surprising.

To determine the diagnostic error in this group of cases, Allen and I⁸ studied all the ulcerating lesions of patients who entered the

CARCINOMA OF THE STOMACH

CLAUDE E. WELCH, M.D., F.A.C.S.*

CARCINOMA of the stomach is the most common cancer of the gastrointestinal tract and causes more deaths than any other single type of malignant disease. In fact Livingston and Pack¹ estimate that nearly

of fatalities from traffic accidents

Yet despite the number of deaths from this disease the number of cures has remained extraordinarily low. Thus the same authors estimate the five year survival rate in most localities varies from 2 to 6 per cent while at the date of publication of their monograph (1939) only three American clinics had ever reported a total of over 100 gastrectomies for cancer.

Since it is obvious that at some stage in its career, every cancer of the stomach is curable by excision, early diagnosis must be followed by prompt adequate and safe surgery to assure control of the disease. How then are these essentials to be attained?

Reduction in the delay from onset of symptoms to surgical therapy is we believe the most important factor of all. In a series of 691 cases observed in the Massachusetts General Hospital from 1927 to 1946 Parsons and I found that half of the patients had entered the hospital five months after their first symptoms had appeared while 5 per cent did not appear until two years after onset. It was depressing to compare that curve with one depicting the experiences in the last ten year period 1937 to 1946 and to find that the two are exactly the same. In other words patients are not coming to the hospital any earlier for treatment than they did a decade ago.

Many attempts have been made to achieve a reduction in this delay. Early recourse to the doctor instead of patent medicines is absolutely necessary. This must be accompanied by a more alert attitude on the part of the general practitioner with reference of the patients to centers where adequate examinations may be made.

Attempts to screen out cases of cancer of the stomach from the general population have not been promising because of the large number of normals that must be excluded for the rare pathological stomach. St. John Swenson and Harvey² using rapid x ray examina

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tions, studied 2413 patients appearing in the outpatient department of the Presbyterian Hospital in New York City for various reasons, but without any gastric symptoms. They discovered three malignant lesions of the stomach. Routine gastric analyses of all patients entering outpatient clinics with further investigations of those who show achlorhydria has also been proposed as a method of discovering early cancer, this method is open to many objections.

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Yet despite the number of deaths from this disease the number of cures has remained extraordinarily low. Thus the same authors estimate the five-year survival rate in most localities varies from 2 to 6 per cent while at the date of publication of their monograph (1939) only three American clinics had ever reported a total of over 100 gastrectomies for cancer.

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Attempts to screen out cases of cancer of the stomach from the general population have not been promising because of the large number of normals that must be excluded for the rare pathological stomach. St. John Swenson and Harvey³ using rapid x ray examina-

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pleural approach for most of the carcinomas of the cardia. On the other hand we do not believe that the entire stomach should be removed for all carcinomas. Total gastrectomy carries a higher mortality than subtotal. Moreover, recurrence after subtotal resections are not in the remaining segment of the stomach but in lymph nodes that cannot be removed.

The transthoracic approach for lesions of the upper portion of the stomach became possible within the past five years. Churchill¹⁰ and Sweet¹¹ in this hospital have developed the method so that it was one of choice in 25 per cent of all the cases operated on within the past year.

Unfortunately nearly 25 per cent of the patients with cancer of the stomach who enter this hospital are inoperable. Distal metastases or extensive liver involvement contraindicate operative intervention except in the presence of actual or impending obstruction. Peritoneoscopy will occasionally demonstrate widespread peritoneal implants making operation unwise. The remaining patients are explored. In some complete fixation of the growth will make excision impossible. In others the primary lesion can be resected but fixed metastatic nodes in the porta of the liver along the hepatic artery or in the periaortic area cannot be removed. It is our policy in all of the cases in which it is possible to remove the primary tumor though gross disease must be left behind in the abdomen. This is not done because of any forlorn hope of cure but because the patient will be more comfortable during his remaining span of life.

Gastric resection then is the most satisfactory of the palliative operations. Gastroenterostomy has practically been abandoned because the stoma frequently obstructs in a short time from progression of the tumor. If the cancer is in the distal stomach and firmly fixed the stomach may be transected, the distal end turned in and a gastroenterostomy performed.

Operative Mortality—The operative mortality has dropped progressively in the past ten years owing to improved anesthesia, more frequent blood transfusions, intravenous alimentation and chemotherapy as well as to technical advances. The three most important technical advances are the introduction of the transthoracic approach, the frequent use of a nasogastric tube, and the use of a

20 per cent in 1937 to 1941 to 11 per cent in 1941 to 1946. This has been a progressive improvement as shown by the fact that only three patients were lost after resection in the year 1946; these three required total gastrectomy and partial esophagectomy.

Prognostic Factors—A study of the 587 gastric resections for cancer

Massachusetts General Hospital from 1930 to 1940. There were 271 that were considered to be benign, however, 14 per cent of them were finally proved to be malignant. A figure of the same magnitude was found by Walters⁸ in the Mayo Clinic, where he found that, in about 10 per cent of the cases, x-ray or gastroscopy will not assist in the differential diagnosis of benign and malignant ulcers.

It thus appears that gastric ulcer is fundamentally a surgical disease because of the frequent confusion with cancer. In an attempt to evaluate the indications for operation we came to the conclusion that patients with gastric ulcer should be subjected to immediate operation if any of the following conditions are present: (1) the ulcer is of short duration in a patient over 50 years of age, (2) the ulcer is on the greater curvature or in the prepyloric area, (3) the ulcer is 2.5 cm. in diameter or over, (4) there is no free hydrochloric acid in the stomach, or (5) the ulcer is chronic and on the lesser curvature. To these should now be added a sixth consideration—a positive Papanicolaou test. On the other hand, hospital observations and medical treatment for a three week period are warranted if the patient is young with an ulcer of short duration, and the ulcer is on the lesser curvature and is small. Healing should be demonstrated in three weeks, and confirmed at an examination a month later in the outpatient department.

It must be emphasized that the diagnosis can be made only by the pathologist with his microscopic examination. The surgeon at the operating table will be unable to tell whether an ulcer is malignant or not, and he should plan the technical details as a cancer procedure, i.e. wide excision with inclusion of the regional nodes.

SURGICAL THERAPY

While diagnosis has not shown general significant improvement in the past ten years, there have been notable advances in the surgical therapy of gastric cancer. Not only have the operative procedures been greatly extended, but all procedures have become safer, and the mortality rates have dropped. Meanwhile the number of resections have increased, so that nearly 50 per cent of patients with cancer of the stomach who enter the hospital have resections. These changes justify a more optimistic attitude toward the future.

It has been established that an adequate resection for gastric cancer should include not only a generous segment of the stomach, and the regional nodes, but also the greater and lesser omenta and a short portion of the duodenum. With lesions of the cardia, a section of the esophagus must be resected frequently. This requires a trans

or pure colloid carcinoma and (6) undifferentiated cancer furnish very unfavorable types. Nearly all patients with these types were dead in a year, and none survived five years.

SUMMARY

Our experience with cancer of the stomach during the past twenty years is reviewed briefly. Further control of the disease is conditioned upon earlier diagnosis. The surgical treatment and prognostic factors are discussed.

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performed in this clinic in the last twenty years has shown the relative importance of certain factors in the determination of the prognosis of the individual patient with this disease. An excellent prognosis may be given to the patient who has a microscopic diagnosis of either carcinoma in situ or polypoid cancer. A fair prognosis may be given to any patient who has a microscopic diagnosis of adenocarcinoma or colloid adenocarcinoma or who is found to have no metastases in the regional nodes. A poor prognosis is found with signet cell or undifferentiated carcinoma if there are lymph node metastases or with fixation of the stomach to other viscera.

The surgeon then can to some extent give the prognosis at the conclusion of the operation. If gross disease is left in unremovable nodes the average postoperative length of life is eight months. If the lesion is firmly fixed to another viscus such as the pancreas or colon a cure is not to be expected even if these viscera are resected. It is our policy none the less to make a wide block resection of all involved tissues so that sections of colon, pancreas, esophagus, duodenum, spleen or liver are frequently included with the specimen. The occasional brilliant result obtained such as reported by Brunschwig¹³ makes the procedure worth while even though the salvage is practically zero.

The pathologist however can give a more accurate prognosis. The presence of metastatic disease reduces the over all five-year survival rate to about 5 per cent while if no metastases are found approximately 50 per cent of the patients will be alive at the end of this period.

The classification of the lesions is not standardized. Some divide the carcinomas into mucosal cells demonstrate all of the characteristics of cancer but there is no evidence of invasion of the basement membrane. It is generally accepted that these lesions are cancers. On the other hand their prognosis is excellent. We have had only one patient die from recurrence after resection. (2) Polypoid carcinoma. Allen and Benedict¹⁷ found that 40 per cent

of these lesions are well differentiated and are among the most common of the stomach cancers. About 40 per cent of all such patients were found to survive five years. (4) Colloid adenocarcinomas often form a bulky tumor. Pathologically they are usually adenocarcinomas which show colloid degeneration. In this series we have found that they behave as adenocarcinomas and the postoperative prognosis in the two groups is about the same. (5) Signet ring cell carcinoma

the whole surface immediately, only that portion is exposed which can be covered. This will avoid a large open wound adjacent to the flap. The rest of the scar is removed when the flap is detached and sutured in place. A suitable area is selected on the abdomen, chest, thigh or calf and the flap outlined with a broad pedicle and a sufficient excess of skin. The bed from which the flap has been raised is usually closed with a free split graft in order to close the open wound and to make the dressings easier. The flap is then sewed in place with buried stitches and a few skin stitches. Occasionally during the dissection



Fig 833—Direct flap repair of extensive soft tissue and bony loss of upper arm as preparation for bone graft to humerus completed in two operations. Functions of hand and forearm not impaired.

of the scar on the hand, an intact tendon may be found fixed in the scar and thus is wrapped in a secondary flap on the undersurface of the abdominal flap in order to give it a bed in which to glide. Also occasionally an osteotomy or a refracture of the malunited or the nonunited bones may be done prior to application of the flap, or small nerves may be sutured. The arm is immobilized by adhesive strips with cotton waste for support and pressure on the flap. The lower extremity cross leg flaps are immobilized with a plaster cast for both holding the parts in position and for supporting them as comfortably as possible. The use of pressure dressings over all flaps is of the utmost

SOME RECENT DEVELOPMENTS IN PLASTIC SURGERY

BRADFORD CANNON, M D *

DURING World War II, just as during World War I, a challenge was given to the plastic surgeons to improve methods and final results in the care and rehabilitation of the severely wounded. The scope of plastic surgery in the recent war has been greatly expanded to include not only deformities of the face and jaws, formerly labeled maxillo-facial surgery, but to include any deformity involving the superficial tissues of the body and many involving the deeper tissues. The general plastic surgeon thus becomes the most ubiquitous of all military surgeons dealing with reconstructive problems, and on the effectiveness of his surface restorations depends much of the success of any later surgery of the deeper structures. The purpose of this paper is to present some of the methods in plastic surgery that have been developed or perfected during the war years.

DIRECT FLAPS

The large and small surface defects of the arms, legs, hands or feet resulting from gunshot shell fragment or other types of wounds may require repair with flaps as a preliminary to deep surgery or for better surface covering over bony prominences. Simple direct methods have saved many weeks of hospitalization and have allowed earlier definitive orthopedic or neurosurgical repairs and functional rehabilitation. With the direct abdominal flap or the direct cross-leg flap, repairs can be completed in as short a time as eighteen days. The flap can be rapidly prepared at the same time that the dissection of the scar is performed, and patterned to fit exactly the shape of the defect. With full allowance for shrinkage an adequate amount of skin to complete the repair is assured. The principle involved in the transfer of a direct flap is that of insuring a sufficiently broad, short attachment for blood supply to the flap in its new position.

To insure diffusion of oxygen and early capillary anastomosis an adequate minute blood supply is essential even if in removing the avascular scar the defect is enlarged. A pattern is used to outline the graft and in cutting it separation of skin and cartilage is to be avoided. The graft is anchored in place with buried stitches and the skin edges sutured accurately. Great care in the dressing is necessary to fix the graft firmly and to apply gentle pressure to it. Support of the graft with a dressing for ten days is usually adequate.

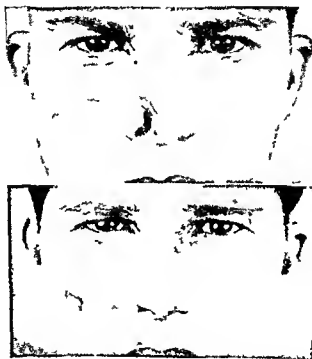


Fig. 334—Single stage restoration of alar loss with composite free graft from the ear. Note minimal deformity of ear with post auricular flap repair. (By permission of Surgery Gynecology and Obstetrics)

Results with composite grafts are better than by other methods and they match the normal nostril borders in color, texture and appearance. In over seventy of these repairs total loss of the graft has occurred in only five cases (Fig. 334).

FULL THICKNESS GRAFTS FROM THE NECK

Full thickness grafts from the base of the neck have proved superior to other grafts in facial repairs. The superiority of the graft may be attributable to the fact that it is underlain by the platysma muscle.

importance to prevent venous congestion, stasis and possible thrombosis, which is often the cause of failure of flaps to survive. All flaps are examined frequently to be sure that there is no kinking of the pedicle.

Direct flaps to the upper arm are practically always to the outer surface since severe injuries to the inner surface involve nerves and vessels and may necessitate amputation. A long flap is needed to reach the outer surface of the arm, but by providing a sufficiently wide base in the anterior axillary line it has been possible, in a large series of patients, to transfer direct flaps from the lateral chest wall to the outer surface of the arm (Fig. 333).

Most of these flaps can be detached after from eighteen to twenty one days but if there is additional flap needed to encircle a portion of the arm or hand it may be necessary to delay the flap once or twice before detaching it completely. Usually at the time that the flap is detached the base can be loosely sutured in place to complete the resurfacing in two operative procedures. But, if the circulation seems questionable there can be a delay of a few days before closure.

Within six to eight weeks after the flaps have been applied it is possible to undertake the deep surgery in the form of tendon, nerve or bone repairs. The presence of subcutaneous fat is essential for much of the deep surgery especially for tendon repairs, but as a final procedure the amount can be reduced.

Sensory regeneration occurs slowly in these flaps if there are sensory nerves in the vicinity but anesthesia persists if the nerves are destroyed.

COMPOSITE FREE GRAFTS FROM THE EAR

Losses of the ala, columella or the tip of the nose due to trauma, burns, wounds or operative causes have always presented a problem because repair by a local flap may alter a normal feature and repair by the transfer of a remote flap requires multiple procedures. The use of composite free grafts from the ear comprising two surfaces of possible these corrections in a either by closure of the defect

These grafts are useful for correcting marginal losses or for restoration of the alar-columella junction. As a wedge they can be used for elongating the ala and as a plaque for flat restorations of the tip. In conjunction with preliminary total resurfacing of the nose with a

often be left off and motion of the graft allowed. If there is superficial blistering of the graft the functional result seems to be unimpaired (Fig. 335).

Not only is the graft useful on the face but it has also been used on the back of fingers where extensor tendon transplantation is contemplated. The graft can be dissected up as a flap and will heal over the tendon. It has not been used for this purpose on flexor surfaces.

REPAIR OF LOSSES OF THE EXTERNAL EAR

Partial or complete losses of the external ear may be repaired satisfactorily with local tissue in as few as two operations. The results by this direct method are usually better than by mobilizing and transferring a distant flap. The method is adaptable to losses from burns, wounds, accidents and freezing as well as to those from congenital



Fig. 336 Reconstruction of upper half of ear with local skin flap and preserved cartilage transplant completed in three operations (Performed by Dr. Joseph E. Murray)

or surgical cases. The frequent presence of other serious defects in association with ear losses increases the importance of a rapid simple method of repair.

The principle in the repair is to implant the freshened stump of the ear beneath the skin behind and above the ear. After healing is complete a piece of preserved costal cartilage carved like the shape of the ear is inserted beneath this nonhair bearing scalp flap. A few weeks later the flap and its supporting cartilage are cut free from the scalp and elevated, being sure to leave soft tissue on the under surface of the cartilage. The opposing raw surfaces behind the ear are grafted with a single large thick split graft. If before starting the repair it is anticipated that there will be a large defect in the ear margin, a free skin graft in fact severe

which corresponds functionally to the muscles of the face. The presence of muscle in the subcutaneous tissues seems to give these skin grafts unique qualities of delicate texture, functional mobility and kindly healing with minimal shrinkage, which makes them ideal for inner canthal and eyelid resurfacing. The color match is usually good. Although limited in amount, enough skin is available for most eyelid, nose or mouth repairs.

In preparing the bed for this graft the deforming scars of the face or eyelid are released and the part returned to its normal position. Any dense scar tissue at the margins of the defect or on the raw sur-



Fig. 335—Correction of ectropion using full thickness grafts from the base of the neck.

Accurate suturing of the graft is done with interrupted stitches which are left long enough to tie over a gauze stent. The stent immobilizes the graft against the raw surface and keeps it under moderate tension. Dressings removed on the fifth or sixth day can

MALIGNANT LYMPHOMA OF THE LUNG AND PULMONARY COCCIDIOIDOMYCOSIS

A Clinic on Surgical Lesions of the Lung with Consolidation*

EDWARD D CHURCHILL MD FACS†

TRUE consolidation of the lung rarely comes to the attention of the surgeon because it is commonly a transient phase of acute inflammation as in lobar pneumonia or tuberculous pneumonia. Consolidation of the lung by blood filling the alveoli is found in hemorrhagic infarction and also following direct trauma when it is called contusion of the lung. In consolidation the air of the alveolar space is evenly and completely replaced by some filling substance usually an exudate or blood and the lung itself maintains its normal size and architecture.

The lesions of the lung that are most commonly encountered by the surgeon diminish the volume of the portion of the lung that is affected. This reduction of the volume or space filling capacity of the organ is either the result of the contracture and scarring that follows chronic inflammation as in tuberculosis or bronchiectasis or the collapse of the alveolar spaces secondary to bronchial obstruction. With long standing bronchial obstruction the secretions of the mucous membrane back up distal to the point of occlusion and produce a partial consolidation known as drowned lung or if infection is present obstructive pneumonitis. This rarely results in an even filling of the alveolar spaces some remaining collapsed and others abnormally distended. The bronchi frequently are dilated sometimes to enormous size and encroach on the space normally occupied by alveoli.

Bronchial obstruction may also act like a valve and produce obstructive emphysema with dilatation of the alveoli and an actual increase in the volume of the lung. Other lesions such as a peripheral tumor may be space-occupying in themselves and displace lung substance in their growth. A similar reduction in the space occupied by the lung is produced by encroachment from without as a pleural effusion.

The two cases to be presented today are therefore unusual not only because they are uncommon disease entities but because they illustrate consolidating lesions of the lung for which surgery was undertaken.

I shall remind you that the striking physical sign of consolidation is

with free skin grafts on both surfaces and with cartilage between. If the ear is still small it can be enlarged by transferring a small tubed flap from the adjacent neck. This is seldom necessary (Fig. 336).

The use of preserved cartilage is an important consideration in simplifying these repairs. Cartilage can be obtained from properly selected patients in the pathology department. All perichondrium is cleaned off and it is stored in merthiolate or some other chemical preservative. Cartilage thus treated has less tendency to curl than fresh cartilage.

SUMMARY

Several methods in plastic surgery which have been developed or perfected during World War II are presented. These include the extensive use of direct flaps to the extremities, full thickness grafts from the base of the neck for face repairs, composite grafts from the ear in nasal reconstruction and repair of losses of the ear with local tissue and preserved cartilage.

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Blood studies were normal. A routine urinalysis was not remarkable. Her serum protein was 7.0 gm per 100 cc. The Hinton test was negative.

X-ray studies of the patient's chest (Fig. 337) demonstrated an area of homogeneous density occupying the upper part of the right lung field extending downward to the sixth rib posteriorly. There was increased linear density in the region of the right hilum extending upward. The subdivisions of the right upper bronchus could not be delineated by tomography.

At bronchoscopy a normal larynx was visualized. The trachea lay in the midline and appeared to be normal. The carina was sharp and not fixed, the left bronchial tree was not remarkable. The right upper lobe orifice was normal and on inspection through a right angle telescope the subdivisions of the right upper lobe bronchus were well visualized and appeared normal. The middle lobe orifice and lower lobe terminals were not remarkable.

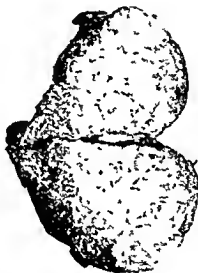


Fig. 338—Photograph of pathologic specimen removed at operation. The specimen consists of the right upper lobe of lung and contains a malignant lymphoma.

While in the hospital awaiting operation the patient was essentially afebrile. After x-ray and bronchoscopic studies were completed, a right thoracotomy was performed removing the fourth rib. On opening the pleural cavity the right upper lobe was found lightly adherent to the chest wall and was consolidated in its upper three quarters. The lower portion of the upper lobe was air-containing but did not appear to represent anatomically a bronchopulmonary segment. The greater part of the lobe appeared to be involved by a process that resembled the consolidation of lobar pneumonia. No enlarged lymph nodes were seen at the hilum. The middle lobe was fused with the upper lobe and was therefore removed together with the right upper lobe after individual ligation and division of the hilar structures. The chest was closed with an intercostal drainage catheter, removed after forty-eight hours.

In her postoperative course the patient did well, and required but one aspira-

is intense bronchial breath sounds. This is produced obviously, not by air entering and leaving the substance of the lung over which the stethoscope is resting but by transmission of the tubular breath sounds of the trachea down the open bronchi and through the solid medium of the lung substance. There is no longer present the dampening air cushion of the peripheral alveoli. When there is bronchial obstruction, even in the presence of consolidation the breath sounds are diminished.

FIRST CASE

This patient a 45 year old housewife, was admitted with the chief complaint of aching pains in the right shoulder.

Six months before admission and again three months before entry, she had bouts of fever and generalized malaise without specific respiratory complaints. The first episode subsided after rest, but the second was more severe and lasted



Fig 837—X ray of patient's chest showing dense area in upper right lobe of lung

two to three weeks. During this time she was given sulfonamides. In the course of her illness and partly here to now she had a fever of nine

F
pain. This aching pain became almost constant with the onset of her present illness. There has been no radiation nor accentuation by cough. Otherwise since the last of her febrile episodes two and a half months ago the patient has felt well, has not complained of undue fatigue, cough, dyspnea, nor has she noted any weight loss. Her past history is not remarkable other than the record of a hysterectomy at the age of 16.

On entry the patient was afebrile and did not appear at all ill. There was no abnormal lymphadenopathy; the liver and spleen were not palpable. The findings on pelvic examination were consistent with a previous supravaginal hysterectomy and no other abnormalities were made out. On inspection no asymmetry of her chest was noted. There was however an area of slight dullness with diminished breath sounds extending from the apex of the right chest anteriorly to the level of the second intercostal space and posteriorly to the level of the angle of the scapula. No rales were heard.

the superior mediastinum of coccidioidal infection agent was negative under medical observation 1946 During this time his mouth lesions improved, but the chest lesion persisted, although the patient had no cough or fever until November, 1946 one month before admission At that time, following an acute respiratory infection, the boy had some cough productive of mucus, slight fever and on two or three occasions he raised a small amount of blood At this time he began to complain of slight left chest pain He was subsequently bronchoscoped but no evidence of intrabronchial disease was observed During the month prior to entry the patient had low grade afternoon fever and had lost perhaps 5 pounds in weight

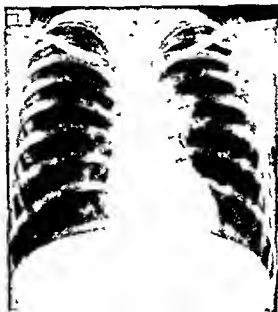


Fig 339—X ray of patient's chest demonstrating a mass in the superior mediastinum to the left of the midline

On entry, the patient appeared to be chronically ill, thin, pale and underdeveloped The skin was rough and dry The buccal mucous membranes showed many white plaques The gums were tender slightly swollen, and bled easily Several small shotty lymph nodes were palpable in the suprasternal notch, and subsequently small nodes were palpable in the posterocervical triangle on the left along the anterior border of the trapezius

Examination of the chest was not instructive No limitation of expansion or asymmetry was noted No clear-cut abnormality could be made out on auscultation or percussion There was no clubbing of the fingers

Examination of the blood revealed a hemoglobin of 10.5 to 11.0 gm, red cell count of 4.8 million white cells 8000, with 82 per cent polymorphonuclears, 11 per cent small lymphocytes, and 7 per cent monocytes The sedimentation rate

tion of 300 cc. of serosanguineous fluid from the right pleural cavity. The lower lobe expanded well. From the tenth through the fifteenth postoperative day, the patient was given a course of x ray therapy consisting of 1200 r through 15 by 15 cm. fields to the anterior and posterior right upper chest and mediastinum. The patient was discharged on the fifteenth postoperative day.

The pathological report from Dr Tracy Mallory on the specimen was as follows "Diagnosis Malignant lymphoma, lymphocytic type, right upper lobe of lung Gross (Fig 338) A right upper lobe measuring 15 by 11 by 7.0 cm. The entire apical portion is firm and bulging. It is tan in contrast to the red inferior portions, and is moderately well demarcated. The pleura is thin and through it the normal markings are seen accentuated by the light background with thin white arborizing lines measuring up to 1 mm in width. A few small adhesions are noted over the apex. On section almost the entire upper lobe is filled with tan translucent homogeneous infiltrate which is especially prominent about the blood vessel walls and bronchi, and which does not seem to destroy the normal lung architecture. The infiltrate is not well demarcated from the pink soft lung

branch of the upper lobe bronchus to be completely infiltrated and replaced about 1 cm. from the bifurcation. The other larger bronchi show thickening of their walls."

Six months after operation the patient is well and there is no evidence of recurrence or residual disease on physical examination or by x-rays.

This localization of a lymphocytic type of malignant lymphoma to one lobe of the lung is unique in my experience. Dr Herbert Maier, of New York City, told me he has seen one similar case. The prognosis must remain uncertain, although by analogy with similar lesions in the gastrointestinal tract it may not be too unfavorable.

The lesson to be learned is obvious. If a mass of this size and consistency were palpated in the abdomen exploration would be urged. Masses in the lung cannot be palpated, but their presence can be detected by x ray examination. When careful study leaves one with a reasonable doubt regarding the true diagnosis, a direct surgical attack may be indicated.

SECOND CASE

The patient, a 14 year old boy, was admitted to the hospital for study and possible removal of a lesion in the left upper chest.

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diagnosis of moniliasis was made. At the time of his arrival in Arizona, fluoroscopy of the patient's chest was negative. In May, 1946, six months later and shortly before his return to

root of the upper lobe was opened and necrotic material removed. A frozen section was reported as chronic inflammation, probably coccidioidomycosis. It was felt advisable, inasmuch as the lymph node filled with caseous exudate had been entered and the lobe itself was consolidated, to remove the left upper lobe. Because of the dense mass of involved nodes around the hilum, it was impossible to do this with the usual hilar dissection, so the old tourniquet method was employed. The lung tourniquet was applied and the lobe removed, except for the normal lingula segment. Deep mattress sutures of No. 0 chromic catgut were placed until all bleeding was controlled, and the stump was then covered by turning the lingula upwards and suturing it over the area. The chest was closed with interrupted silk to the various layers, and drained by an intercostal catheter.

Postoperatively the patient had a moderately stormy course, but the left lower lobe expanded well. The operative wound healed per primam. At the time of his discharge nineteen days after the lobectomy, the patient felt reasonably well, although he continued to run a low-grade temperature. His general appearance was, if anything, improved. An x-ray of the chest a few days prior to discharge



Fig. 340—X-ray six months later, showing growth of mass to occupy apical portion of left upper lobe of lung.

revealed fine mottling of the right lung field, suggestive of possible spread. *Coccidioides* were found in the sputum for the first time after operation, previously they had not had free access to the bronchus.

Pathological report of the operative specimen was as follows. "*Diagnosis Coccidioidomycosis Gross*. The upper lobe of lung measures 12 by 8 by 4 cm. The hilar portion is largely occupied by a concave, white, firm, fungating wall of an abscess cavity. Only a small bronchial stump can be made out. There is adherent fibrous pleura over the apex and beneath it is a very firm, yellow gray tissue. Only a small amount of uninvolved lung tissue is noted posteriorly and even here a few, white, firm, flat, nodular subpleural areas measuring up to 1.5 cm in diameter are seen. No lymph nodes are found. On section almost the entire upper lobe of the lung is consolidated, yellow and firm, with only a few lung markings still visible in the involved area. Grossly, it resembles tuberculous pneumonia."

Culture of the lung tissue removed at operation showed many large and small spherules of *coccidioides* which grew into mycelium in culture. No other organisms were demonstrated.

While it is likely that the diagnosis might have been made on clinical evidence by physicians of the Southwest who see the disease

was within normal limits. The serum protein was 7.4 gm. per 100 cc. with an albumin-globulin ratio of 1.6. Serum calcium, phosphorus and phosphate were within normal limits. Serum sodium and chloride level were slightly low, but the patient showed an adequate diuresis with the water ingestion test (Kempner).

Bacteriologic analysis of the mouth lesions yielded *Moulinia candida albicans*, an organism which was not sensitive to penicillin or streptomycin in vitro. Alpha hemolytic streptococcus was also recovered from the patient's mouth. Intradermal tests using Old Tuberculin 1:10,000 and 1:1,000, histoplasmin 1:100, and coccidioidin 1:100 were all negative. The Hinton test was negative.

X ray studies of the chest demonstrated a 6 cm. area of increased density lying anterior to the left hilum, and extending anteriorly to the chest wall. This shadow partially surrounded the left main bronchus and appeared to cause pressure on the superior margin of the left — there were no elsewhere seen the size of the

During the course of his hospital stay, the patient failed to show any improvement. He continued to have a rapid pulse and ran a low grade febrile course that gradually became more severe.

No definite diagnosis could be established. It was not possible even to differentiate clearly between infection and neoplasm, although the former seemed more likely. One fact did appear certain, at least to those of us familiar with the surgery of the lung—whatever the nature of the lesion it could not be eradicated by surgical operation. This was established by the involvement of the hilar lymph nodes and the adjacent lymph nodes in the mediastinum.

Under these circumstances, considering the enfeebled condition of the child, it was decided to treat the lesion as if it were an infection and to use chemotherapy in an empirical manner. Magnum doses of penicillin were given, as in bacterial endocarditis, and then a course of streptomycin. No favorable effects were observed, and in fact, the deterioration of the patient's general condition seemed accelerated.

The patient had a dry cough that persisted from the time of admission and was at times productive of a little whitish sputum. Repeated examination and cultures of the sputum shed no light on the diagnosis. A biopsy of a slightly enlarged cervical node was done but no diagnosis other than chronic inflammation was made. Culture of the node yielded no growth on aerobic and anaerobic culture, and on Sabouraud's medium.

AN ANALYSIS OF THE CASES OF HIATUS HERNIA TREATED BY SURGERY AT THE MASSACHUSETTS GENERAL HOSPITAL

LAMAR SOUTTER M D F A C S *

As early as 1853, Henry I Bowditch, a visiting physician at the Massachusetts General Hospital in a review of the literature and the presentation of a case of diaphragmatic hernia, suggested that surgery might be tried as a last resort in the treatment of this disease because of the poor results obtained by the use of emetics, leeches, cathartics venesection, bathing and ether. The surgical staff, however, did not act on this suggestion immediately. The first operation was not performed until 1898 and then inadvertently, with the true diagnosis unsuspected preoperatively. In 1911 the first elective repair was successfully executed using a positive pressure anesthesia. In neither case is there proof that the hernias were of the hiatus type. It was not until 1920 that the first true hiatus hernia repair was carried out. From then until January 1st 1947 some seventy two operations have been performed on sixty six patients for this disease. This total includes twenty five operations through the abdomen, four phrenectomies prior to abdominal exploration, five phrenectomies for therapeutic reasons and thirty eight transthoracic operations.

INDICATIONS FOR SURGERY

There have been many times when the diagnosis of diaphragmatic hernia has been made roentgenologically at this hospital in the past thirty years but only a small number of the patients so diagnosed have reached the surgeon. This is because a large number of these people have no symptoms referable to their hernias or else their symptoms are sufficiently mild or infrequent to be adequately controlled by diet and medication. Those who were admitted for surgical intervention were generally persons who had suffered from symptoms of increasing severity and frequency over a considerable period. The longest time from onset of symptoms to surgery was twenty six years, the shortest two weeks and the average from two to five years. Nearly all of these patients had been treated by several different doctors before being referred to a surgeon. The signs and symptoms which most frequently preceded operation were severe pain, heartburn, anemia, vomiting, obstruction, bleeding, anginal pain or difficulty in

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more frequently than we do here, it was impossible to recover the specific organism without the operation described. At no time was it felt that surgery could be effective in treatment, and in fact lobectomy was only a magnified form of biopsy. The subsequent course has shown this to be true, as after return to his home, the boy's condition steadily deteriorated to a fatal termination.

Review of the excellent descriptions of the pathology of pulmonary coccidioidomycosis in the November, 1946, number of *The Military Surgeon*, shows the phase of the disease with which we were dealing, a consolidation of the lung substance as in lobar pneumonia.

The monilia was purely a red herring in the diagnosis. While we speculated as to whether the pulmonary lesion could be a manifestation of moniliasis, this interpretation was never accepted. The boy was like a piece of damp bread, a suitable host for fungi. He had carried monilia all his life and as soon as he arrived in Arizona picked up coccidioides.

Symptomatically, the results are more encouraging. Forty-two patients were relieved before discharge from the hospital, one died, and another left unimproved. Concerning the remaining twenty-three,

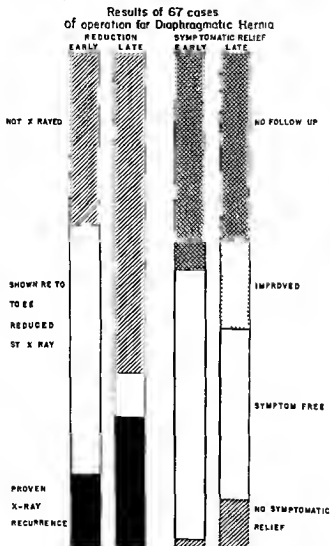


Fig 341—Results in 67 operations for hiatus hernia at Massachusetts General Hospital.

we could find no reports in their records. Twenty-seven patients were followed less than a year or were untraceable. Of the remaining forty, ten reported that they were unimproved by operation, nine were un-

swallowing bulky foods. Most of the patients had a combination of complaints, none was completely free from pain. Twenty four complained chiefly of severe pain, seventeen others were troubled by both pain and vomiting, nine had partial gastric obstruction, three had symptoms strongly suggestive of angina pectoris, and several others had mild complaints of the same sort. In none of those complaining of anginal pain could actual heart disease be found. Six experienced dysphagia, six were dyspneic, nine gave a history of bleeding of which there was no proof by laboratory studies. In thirty cases, blood was demonstrated in the vomitus or stools. Fourteen patients were anemic, ten of these severely so, in only one was any cause other than the hernia to be found. Gastritis was demonstrated by roentgenological methods in eleven of the patients who came to surgery. Of these seven had had episodes of bleeding or were anemic. Fifty-one patients were described as obese, four as thin and the remainder not described.

THE RESULTS AS A WHOLE

In Figure 341 are listed the results for all the operations with the exception of the four phrenicectomies done prior to abdominal repair and one transthoracic operation in which the surgeon decided not to do a repair because an inoperable mediastinal tumor was found as well as the hernia. The results are grouped according to operative cure, as demonstrated by roentgenological studies with barium contrast media, and by symptomatic cure according to the relief of symptoms. In many instances because of symptomatic relief, no postoperative x rays were taken either before leaving the hospital or later on, so that for these patients we have no proof of cure. In other cases, the patients were shown to have small protrusions of their stomachs above the diaphragm but their hernias were shown to have been almost completely reduced. For purposes of this paper, however, the latter are listed as recurrences. An arbitrary division has been made into early results those obtained prior to the patients leaving the hospital and late results those obtained more than a year postoperatively. Symptomatically, the patients have been divided into four groups: those on whom we could obtain no follow up data; those who were not relieved; those who are symptom free and those who are much improved.

In Figure 341 are depicted the results of sixty seven operations. In thirty five cases the hernias were shown to be reduced in ten more recurrences were demonstrated and for the remaining twenty five cases no roentgen ray studies were done before the patients left the hospital. Forty three of these people were followed less than a year or were not studied roentgenographically. Of the remaining twenty-four, eighteen had proven recurrences and six had proven reductions by studies taken at least twelve months postoperatively.

recurrence by roentgen ray studies. The hernias of five were demonstrated to be cured and the remaining twelve were not studied in this manner. After a year's time two more recurrences came to light, but no further studies were made on the other patients. This means that if statistics are applicable to so small a group, we can find definite evidence of recurrence in ten patients who had a subdiaphragmatic repair of a hiatus hernia or a total of 40 per cent of those repaired in this manner.

Symptomatically the improvement is better than might be expected by those discouraging figures. Prior to leaving the hospital, only one patient was unrelieved symptomatically, and only one did not survive the procedure. For nineteen others we have no data as to improvement, but the remaining four were symptom free. After a year or more, there were but four patients who felt no better than preoperatively. Two were completely relieved, five much improved, and on fourteen we have no reports.

There was one death in this series, that of a patient who had had a cholecystectomy and a hiatus herniorrhaphy at the same time. The death was from overwhelming infection in the early postoperative period. Less serious complications were experienced by four other patients, namely minor wound sepsis in two and sublethal pulmonary infarcts in two more. Ventral hernias were found in the abdominal incisions of two patients at a far later date.

2 Phrenicectomy—Although first employed preliminary to the abdominal repair of hiatus hernia, phrenicectomy has been used on five patients in our series as the only surgical therapeutic measure. Its use had

major results demonstrated by roentgen ray studies. The same four showed complete or nearly complete reduction postoperatively; all five were improved symptomatically. Within a year, however, in the three who were followed there was complete recurrence of symptoms and demonstrable recurrence of herniation accompanying return of diaphragmatic motion. It is of some interest to note that one patient who had roentgenological evidence of a nonreducible hernia but whose left phrenic nerve was crushed in the neck two weeks before

in thirty seven patients who had their hernias repaired transthoracically are shown. There are two recurrences demonstrated by barium swallow before the patients left the hospital. Postoperative hernia reductions were seen in twenty five others. No barium studies were made on the ten remaining persons. After a year or more postoperatively, the total of proven recurrences had risen to five. The

proved but not completely relieved, and twenty-one are symptom-free. This means that among people adequately followed, good results were obtained following operation in 75 per cent of the cases.

THE RESULTS BY TYPE OF OPERATIVE PROCEDURE

1 **Transabdominal Repair.**—In the decade from 1920 to 1930, the abdominal operation was the only one used. From 1930 to 1940 it was still widely employed, but since 1940 the transthoracic approach has

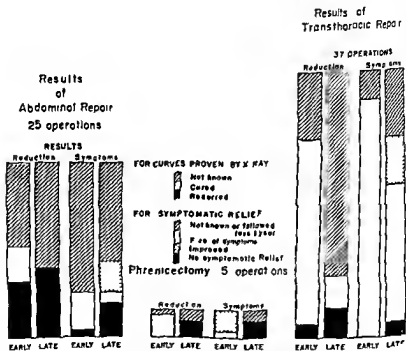


Fig 342.—Comparison of results obtained in operations for hiatus hernia by abdominal repair, transthoracic repair and phrenicectomy

a third of the twenty five who had this operation gave evidence of

2 The recurrence rate to date has been relatively high, at least 14 per cent after transthoracic repair and at least 40 per cent after abdominal repair in this series

3 Symptomatic relief occurs in a much higher percentage of patients and is far more important Of those patients operated on through the abdomen only 16 per cent were known to be unrelieved a year or more postoperatively Of those operated on through the chest, only 8 per cent are known to be unrelieved The follow up is not complete

4 For patients with hiatus hernia who are suffering from much pain vomiting obstruction, severe anemia blood loss or anginal pain, surgical treatment is the one of choice with a lower mortality and a greater relief of symptoms than can be achieved medically,

5 The incidence of recurrence will be less and the relief of symptoms greater in transthoracic repairs than in abdominal repairs

6 The value of phrenicectomy is probably limited to transient symptomatic relief in those patients whose hernias are shown by roentgen ray to be reducible

proven reductions were six. Twenty six patients have either not been studied by roentgen rays or have not yet been followed for as long as a year. This makes a known recurrence rate of 14 per cent.

Symptomatically, thirty three of the patients were relieved at the time of their discharge. No comment was made regarding the other four. In the late follow up there are nine cases who either could not be traced or had been operated on less than a year before this study was begun. Three persons were symptomatically unrelieved (two showed roentgenological evidence that their hernias were larger than preoperatively). Six patients were improved and nineteen were symptom free. This represents a symptomatic failure of about 8 or 9 per cent, two failures on a technical basis and one because of inadequacy of the operation as a therapeutic measure. The follow up in this series is better. The hospital records are more complete and there is adequate evidence that in a general hospital when done by a variety of surgeons the operation has more to offer than the repair through the abdomen. However it should be noted that the recurrence rate is materially higher for the inexperienced surgeon which would make one feel that results will be better in the hands of older men with some experience in the matter.

The complications were two cases of severe pulmonary atelectasis, one of minor wound infection, one of empyema, and two of pulmonary infarct (nonfatal). This represents a total of six complications in thirty seven operations, or about 16 per cent. This group of cases, as compared with the abdominal ones, have been operated on when improved surgical technic, better anesthesia, and modern chemotherapeutic agents have materially reduced the incidence of complications. There were no deaths. The operating time was, on an average, about the same as for the abdominal approach, the added length of time of opening and closing the chest being compensated for by the diminished time of repair due to better exposure. It has been possible to operate on very large hernias with adherent sacs by this route.

CONCLUSIONS

This is a small series of cases in which three different surgical operations were employed by a variety of surgeons. It is too small for definite conclusions to be drawn as to the best method of attack of this problem. The following tentative conclusions may be made:

1. Diaphragmatic hernias may be satisfactorily repaired with a mortality that is low despite, in some instances, severe anemia, debility, and obstruction. In thirty seven cases, by the thoracic approach, it was zero; in twenty five by the abdominal approach, it was 4 per cent.

different clinical and etiological entities. It is difficult, for example, to explain the difference between cases of achalasia and Scott's so-called "dolicho esophagus" excepting that the latter represents an extreme degree of the former. His other two groups, namely the "true cardiac spasm" which is a reflex response to a neighboring focus of disease such as gastric ulcer, and "dilatation associated with constriction at the cardia" where there is an anatomical obstruction in the form of a constricting band or periesophagitis, apparently bear no relation either clinically or anatomically to true idiopathic dilatation. Instead of mixing together a group of dissimilar conditions it is better to ad-

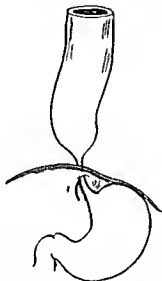


Fig. 343.—Diagram showing the anatomical characteristics peculiar to the condition known as idiopathic dilatation of the esophagus. Note: The cardia is of normal diameter. The lower portion of the esophagus, including the majority of the abdominal portion and a short length of the thoracic portion, is abnormally small in diameter. Proximal to the narrow segment there is enormous dilatation of the esophagus and hypertrophy of its wall.

here to the obvious clinical entity known as achalasia or true idiopathic dilatation. The resemblance of this condition to idiopathic dilatation of the colon is striking and each may ultimately be proven to have a common etiologic relation.

There is danger in a discussion of this condition that too much emphasis may be placed on the strictly anatomical aspects. That a functional or physiological disturbance coexists with the structural changes must be emphasized no matter how impossible it may be to determine which is the antecedent of the other. It must be admitted also that emotional disturbances play a part in the severity of the

IDIOPATHIC DILATATION OF THE ESOPHAGUS

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IDIOPATHIC dilatation of the esophagus presents a characteristic anatomical picture. There is in these cases a normal appearing cardiac orifice which has a normal diameter. Beginning just above the cardia and extending proximally, the esophagus is narrow, often not segment the wall of the evidence of inflammation in this portion nor in the surrounding mediastinal tissues. No adhesive bands can be found nor any other evidences of mechanical constriction. Proximally this abnormally narrow and hypoplastic segment ends in a funnel shaped widening of the organ which often assumes enormous proportions. In the cases where the esophagus above is exceptionally wide the organ tends to swing to the right and in extreme instances reaches the chest wall on that side. It is often so large that it will hold several quarts of fluid. In this dilated portion the esophageal wall is tremendously thickened in both its mucosal and muscular coats, principally the latter. No matter what theory of its etiology may be held these are the constant and striking anatomical findings (Fig. 343).

Attempts to explain the etiology of idiopathic dilatation of the esophagus have led to the adoption of certain terms which have come to be used as synonyms in the designation of the condition. Thus the erroneous concept that the disease is the result of spasm at the cardia led Mikulicz¹ and Meltzer² to suggest the term "cardiospasm" a term which although it gives a false impression regarding the nature of the condition has continued in common use ever since. A more useful term arose from the hypothesis evolved by Hurst³ which postulates that the difficulty arises from a failure of the segment of the esophagus just above the cardia to relax when a wave of peristalsis reaches it. This presumed physiologic disturbance was called by Hurst "achalasia" and was thought to be the result of degeneration or absence of the ganglion cells in Auerbach's plexus in the narrow segment. This theory is appealing and remains probably the best explanation of the development of the condition which is available at the present time.

A recent attempt by Scott⁴ to clarify the situation by differentiating four as a

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Technic of Operation.—The technic is as follows. A transthoracic incision is made on the left side, resecting the ninth rib. If the patient is young an intercostal incision is used through the left eighth interspace. The mediastinal surface of the pleura overlying the lower portion of the esophagus is incised longitudinally and the esophagus at that level is mobilized, taking care not to interfere with its blood supply by preserving the anastomotic branches from the left gastric artery, the inferior phrenic artery, and the lowermost aortic esophageal artery. The pathologically narrow segment is identified and its length is observed.

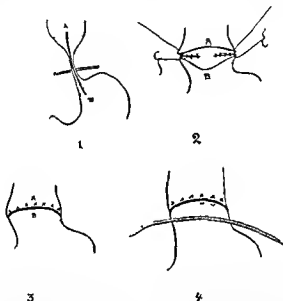


Fig 344—Diagram illustrating the technic of longitudinal incision and circumferential closure. 1 Relative length of the incision required. The proximal end (A) is at a level where the lumen is as wide as at the level chosen for the distal end of the incision at or just below the cardia (B). 2 Beginning of the closure, starting midway on each side of the longitudinal opening produced by the incision and proceeding circumferentially. 3. Circumferential closure completed. 4 Relation of the closed incision to the level of the diaphragm.

A point on the anterior surface of the esophagus at a level where the lumen is sufficiently wide to function well is chosen as the upper limit of the longitudinal incision (Fig 344). The lower limit of this incision must lie at or just distal to the cardia where the diameter of the lumen is equivalent to that chosen on the esophagus above the narrowed segment. An incision is then made from the wide upper point (Fig 344, A) to the wide lower point (Fig. 344, B) through all layers of the anterior wall. The opening which results is then closed

symptoms and that some patients are enabled to lead a satisfactory existence as a result of having such difficulties eliminated by skillful advice and suggestion from their medical attendant, whether he be psychiatrist or family physician. The underlying structural changes of course, remain and may sooner or later require treatment.

SURGICAL TREATMENT

for this is difficult to comprehend. Furthermore, a certain number of patients appear to respond favorably to psychotherapy with or without the mechanical aid of bougenage. There are those, however, who even after a faithful trial of these conservative measures are still unhappy and uncomfortable because of inability to eat in a normal fashion. Many of these develop social difficulties arising from the or mechanical obstruction that their state of nutrition suffers. Enormous losses of weight may occur and surgical intervention becomes imperative. It should be said also that some patients seek the services of a surgeon because they have become discouraged over the necessity for repeated dilatation and ask for a more permanent or definitive type of treatment.

Choice of Operation.—Several surgical methods for the relief of idiopathic dilatation of the esophagus have been proposed and subjected to clinical trial. These include resection and reanastomosis, longitudinal incision of the muscular coats of the narrow segment, lateral esophagogastric anastomosis and various forms of cardioplasty such as those proposed by Ochsner and DeBakey³ and by Scott.⁴ The total number of cases operated upon by any method yet proposed, as judged by reports in the American literature, is small (twenty one reported cases up to 1945 to quote Scott⁴ who includes three cases of his own). The total experience with any one of these operations therefore has not been large enough to warrant drawing any definite conclusions concerning their value. On the other hand, all of these methods excepting the Heller operation of longitudinal incision of the muscle fibers have been tried at the Massachusetts General Hospital with varying degrees of success.

so that a long term follow up study of the results cannot be made at the present time, the results have been so satisfactory thus far that it seems reasonable to continue the use of this operation in intractable cases of idiopathic dilatation of the esophagus

The following case report serves to illustrate the type of case which can be expected to respond well to the operation

CASE REPORT

M D 31 years of age was admitted to the hospital on February 19 1947. She had had difficulty with swallowing for many years. It had apparently started when she was about 18 years old but careful questioning revealed that she had never been able to swallow exactly normally. She had considerable difficulty in getting solid food through unless she washed it down with swallows of liquid.



Fig 345—Preoperative roentgenogram (in case reported) after ingestion of barium showing the dilated esophagus above an exceedingly narrow segment which empties into a normal appearing stomach

The difficulty would increase steadily over a period of time until she would have bougienage which would provide temporary relief. She disliked the procedure to such an extent however that she was anxious to have some alternative permanent treatment if it was available. She seemed to have maintained her nutritional status fairly well and had not lost much weight. She had had one child. She was anxious to have other children but was loath to do so because she had been extremely ill during pregnancy as a result of the esophageal difficulty.

On examination the patient was a rather pale, sallow, somewhat phlegmatic young woman. The heart and lungs appeared to be normal. There was no deviation of the trachea. Palpation of the abdomen was negative.

in the opposite or circumferential direction so that at the completion of its closure points A and B (Fig 344) are approximated. This maneuver serves to eliminate the long narrow segment of esophagus and substitutes for it a lumen of large size equivalent to or slightly greater than the actual diameter of the cardia. The actual technic of the closure is identical with that used for esophagogastric anastomosis with three layers of fine silk interrupted sutures.^{6, 7}

As a result of the circumferential closure of what is often a relatively long longitudinal incision, considerable shortening occurs. This is principally at the expense of the fundus of the stomach in the region of the cardia and necessitates a moderate amount of mobilization of this portion. If the vasa brevia and upper portion of the gastrophrenic ligament are short, a condition which prevails in the majority of patients, it is necessary to incise the diaphragm a short distance from

surface of the diaphragm. After the esophageal incision has been closed the cut edges of the diaphragm are sutured to the stomach where it passes through the diaphragm in a manner similar to that used in cases of resection of the cardia and lower esophagus described elsewhere.⁶

At the completion of the operation a catheter is led out through a short incision in one of the lower intercostal spaces, the lung is expanded fully and the chest wall is closed in layers using silk technic. The postoperative management of the case is essentially the same as in the carcinoma group after resection and anastomosis.^{8, 9}

EXPERIENCE WITH THE OPERATION

Longitudinal incision with circumferential closure of the pathologically narrowed esophagus has been carried out in 15 patients with

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 pletely mobilized as well as those patients who were underweight or in some cases actually emaciated have gained back to a normal level. There have been no persistent complications or sequelae. The most frequent complaint which has been

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On examination the patient was a rather pale, sallow, somewhat phlegmatic young woman. The heart and lungs appeared to be normal. There was no deviation of the trachea. Palpation of the abdomen was negative.

Röntgen-ray examination showed the esophagus to be uniformly dilated to approximately 8.5 cm. Its contour was smooth and there was smooth conical narrowing just above the cardiac orifice. No peristaltic waves were seen within the esophagus. The barium emptied almost constantly through a narrow channel so that the stomach was well shown after about ten minutes. Both the stomach and the duodenum appeared normal (Fig. 345).

portion of the abdomen. An incision was made in the mediastinal pleura anterior to the aorta and the lower end of the esophagus was freed. The narrowed portion



Fig. 346—Postoperative roentgenogram after ingestion of barium obtained ten days after surgical correction by longitudinal incision and circumferential closure. Note the wide-open passageway from the esophagus into the stomach.

of the esophagus lay definitely above the cardia but was not as long as in many cases, extending only approximately 3 cm. into the thoracic portion of the

stomach. This made it possible to pull the fundus up to a point where the diameter of the esophagus was large.

A longitudinal incision was then made from a point about 1.5 cm. below the cardia to a point about 3.5 cm. above the cardia into the wide portion of the

esophagus This incision was made through all layers It was then sutured transversely in the usual manner, using interrupted fine silk as the suture material Three layers were applied This made an excellent closure and the lumen was in this way widened to a diameter which was equivalent to that of the esophagus at a point where it was somewhat larger than the normal diameter

Following this the edges of the diaphragm were approximated to the fundus of the stomach where it passed through, care being taken not to produce a constriction, and the remainder of the incision in the diaphragm was closed. The edges of the pleura were brought together A Foley catheter was led out through one of the lower interspaces Penicillin was injected both above and below the diaphragm and the chest wall was closed in layers using silk technic with pericostal sutures of catgut. The vagus nerves were not very prominent, but they were not interrupted The phrenic nerve was crushed with a hemostat

Postoperatively the patient did very well At the time of her discharge from the hospital on the twelfth day after operation she was eating a soft diet with no difficulty, her wound was well healed, and aeration of both lungs was normal A postoperative swallow of barium showed good function of the esophagoplasty (Fig 346)

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RADICAL TREATMENT OF MALIGNANT MELANOMAS OF THE LOWER EXTREMITIES

ERNEST M. DALAND, M.D., F.A.C.S.*

"BLACK CANCERS" or malignant melanomas are among the deadliest of all tumors. They may arise in preexisting moles or, more commonly, occur spontaneously. They are distinguished by their black or blue black pigment although the amelanotic type with no pigment is just as serious a tumor. They may appear in any part of the body but the skin, particularly of the extremities, is a favored site. They are the commonest type of malignant skin lesions found on the lower extremities.

Until it was realized that they were of ectodermal origin they had been spoken of as melanotic sarcomas or melanocarcinomas because of their resemblance to connective tissue and epithelial tumors. Early and radical surgical treatment is required if patients suffering from this condition are to be cured. Radiation is rarely effective, although a few cases have been reported where the tumor was retarded in its growth.

In a previous report from this hospital and the Massachusetts State Cancer Hospitals¹ studies were made on sixty-one primary cases in which operation was done. Thirteen of these patients (21 per cent) were well after five years. However, only three of these had metastases to lymph nodes. Taylor and Nathanson² in a later report, and using many of the same cases, found 25 per cent of five-year cures in 265 cases but there were only seven patients who survived if node metastases were present. This is a higher cure rate than in some more common tumors, but it is apparent that if the lesion is not treated in its early stages the prognosis becomes bad. However, there are a few cures in the more advanced cases and radical treatment should be offered where possible.

The spread of malignant melanomas may be (1) through the blood stream to the liver, lungs and bones, (2) via the deep lymphatics with involvement of nodes but with no deposits between and (3) via the superficial lymphatics with nodules in the skin, fat and fascia. There is no way to tell by which route a particular lesion will spread and it may spread by all three routes. The lymphatic drainage from

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the foot and calf is through the superficial and deep lymphatics to the femoral nodes and the iliac nodes. The posterolateral lymphatics course through the popliteal nodes, but rarely are these nodes involved either by infection or metastases.

Wherever possible a wide removal should be done of the primary lesion and a block dissection of the regional lymphatics carried out. However, this may not be enough and in some cases it is necessary to remove the skin fat and fascia between the primary lesion and the nodes. In the cases reported below the course of the lymphatic chains was mapped out by the metastatic nodules and the tissues to be removed were easily determined.

CASE 1—E. M., a man aged 51 years was referred to the Massachusetts General Hospital on January 30, 1932. He stated that he injured his right heel on a truck nine months before and that the wound did not heal. He had been treated by silver nitrate and ointments without benefit. Five weeks ago he noted a swelling in the right groin and decided to secure other advice. Operation was advised and he was referred to the Pondville Hospital.

On admission to the Pondville Hospital (Case No. 4272) a few days later examination showed a 3 by 3 cm. raised indurated lesion on the inner aspect of the right heel (Fig. 347). It was ulcerated and seemed quite invasive into the deep structures. A hard mass of lymph nodes was palpable in the saphenous region but no nodes could be felt in the inguinal area. A film of the chest was negative for metastases.

Operation was carried out by the writer on February 15, 1932. A wide excision was done of the growth on the heel and the dissection extended down to the periosteum of the os calcis. The edges were undercut and the wound partly but not completely closed. Removal of the superficial nodes in the inguinal region and all the contents of Scarpa's triangle was done at the same sitting. The long saphenous vein was ligated and partially removed. Catgut technique was used and the wound was drained. (It is to be noted that the radical groin dissection with removal of the deep inguinal and pelvic nodes as now carried out was not done in this case.) The popliteal nodes were not involved and were not removed.

The microscopical report on the foot lesion by Dr. Shields Warren was: "(1) Beneath an ulcerated area covered with necrotic granular material there are numerous small groups and clusters of atypical spindle-like cells with round vesicular nuclei, many of which are hyperchromatic. Groups of these cells are found throughout the subcutaneous tissue invading the dermis and corium. Atypical and typical mitoses are very numerous. There is no pigment seen in the section. *Diagnosis:* Amelanotic sarcoma. (2) Sections of lymph nodes reveal the complete replacement of the internal architecture by clusters and groups of the same spindle-like cells and many mitoses can be seen. *Diagnosis:* Amelanotic sarcoma."

Two months after the patient's discharge he was readmitted. There were no recurrences in the operative scars, and both wounds were healed. However, he now had a row of black nodules extending from the heel to the saphenous wound, varying in size from 1 to 3 cm. These could be felt in the subcutaneous tissue but bulged the skin outward and appeared like a chain of lymph nodes. The chest film was again negative for metastases.

On June 6, 1932, a second operation was performed. A strip of skin 51 cm. long was removed from the heel to the groin, varying from 8 to 12 cm. in width. With the skin all fat and fascia was removed. The wound was left open for

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ERNEST M. DALAND, M.D., F.A.C.S.*

"BLACK CANCERS" or malignant melanomas are among the deadliest of all tumors. They may arise in preexisting moles or, more commonly, occur spontaneously. They are distinguished by their black or blue black pigment although the amelanotic type with no pigment is just as serious a tumor. They may appear in any part of the body but the skin, particularly of the extremities, is a favored site. They are the commonest type of malignant skin lesions found on the lower extremities.

Until it was realized that they were of ectodermal origin they had been spoken of as melanotic sarcomas or melanocarcinomas because of their resemblance to connective tissue and epithelial tumors. Early and radical surgical treatment is required if patients suffering from this condition are to be cured. Radiation is rarely effective, although a few cases have been reported where the tumor was retarded in its growth.

In a previous report from this hospital and the Massachusetts State Cancer Hospitals¹ studies were made on sixty-one primary cases in which operation was done. Thirteen of these patients (21 per cent) were well after five years. However, only three of these had metastases to lymph nodes. Taylor and Nathanson² in a later report, and using many of the same cases, found 25 per cent of five year cures in 263 cases but there were only seven patients who survived if node metastases were present. This is a higher cure rate than in some more common tumors, but it is apparent that if the lesion is not treated in its early stages the prognosis becomes bad. However, there are a few cures in the more advanced cases and radical treatment should be offered where possible.

The spread of malignant melanomas may be (1) through the blood stream to the liver, lungs and bones; (2) via the deep lymphatics with involvement of nodes but with no deposits between; and (3) via the superficial lymphatics with nodules in the skin, fat and fascia. There is no way to tell by which route a particular lesion will spread and it may spread by all three routes. The lymphatic drainage from

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melanomas Thirty x-ray treatments were given to the recurrent nodule in Pittsfield but it continued to grow She was pregnant at this time and was delivered in December

On examination, a scar of a radiated lesion was noted between the first and second toes with no recurrence of the tumor There was a recurrent, firm, pig-



Fig 349



Fig 350

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mented lesion over the lower portion of the left tibia measuring 4 by 4 cm and above this was a healed scar A firm node was palpable in the saphenous region. Between the larger mass and the saphenous node several subcutaneous nodules

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have a recurrent nodule 5 inches above the knee along the edge of the old skin. This was removed and found to be malignant.



Fig 347

Fig 347 (Case I) —Malignant melanoma of heel before operation. (Reproduced by permission of the New England Journal of Medicine)



Fig 348

Fig 348 (Case I) Four years after removal of skin and fascia and application of thick split grafts. Note absence of swelling.

He returned to work in a shoe factory immediately after operation. He never has had any swelling of his leg although he stands on his feet all the time he is working (Fig 348). He has not been seen in the clinic for several years. However, his local physician visited him in June 1946 and reported that there had been no recurrence.

Comment—The course of the lymphatics draining the man's heel were as carefully marked out as if they had been drawn in ink. The surgical treatment was obvious.

CASE II E. B., a housewife of 22, was first seen at the Cancer Section of the Westfield Sanatorium in February 1943. She stated that five years previously a pigmented lesion appeared between the first and second toes of her left foot. It was treated by x-ray in Arkansas and there has never been any recurrence. Early in 1942 a metastasis appeared over the right lower tibia and thus a higher nodule were removed in August 1942. These were reported as malignant.

it to be a malignant melanoma. Recurrence appeared in two weeks and she was referred for more radical treatment.

Because of difficulties in obtaining a bed at the Massachusetts General Hospital she went to the Palmer Memorial Hospital for operation (Case 42 1303) a few days later. On admission it was noted that she was a frail thin woman weighing 85 pounds. On the outer aspect of the right leg just above the ankle is a recently healed incision adjacent to which are two small black elevated nodules the largest 5 cm in diameter. There are several small nodes in the saphenous and inguinal regions but they seem to be of no significance. Liver edge not felt. There are no enlarged nodes to be felt in the popliteal region. Films of the chest were negative for metastases.

On August 31 a wide excision of the involved area was carried out by Dr. Clifford Franceen. All tissues were removed down to the muscles and to the periosteum of the fibula. The pathological report by Dr. Shields Warren was "malignant melanoma with invasion of the lymphatics." Four days later the defect was covered by a skin graft.

On January 22, 1943 the patient was readmitted with a 2 cm node overlying the inguinal ligament. There had been no recurrence in the scar. Radical groin dissection was performed by Dr. Franceen. All of the nodes in the femoral and inguinal regions and all the nodes along the iliac vessels were dissected out. Two positive nodes were found in the superficial tissues and one out of seven in the iliac region was involved.

In May 1943 a new nodule was excised from high up on the right thigh and this was positive. Other nodules appeared in November.

The patient was readmitted in January 1944 for consultation by various members of the staff. At this time the entire leg from the ankle to 1 inch below the groin scar is peppered with elevated melanotic spots half the size of black

chance. One surgeon advised radiation and the radiologist strongly advised radical excision. Others considered her hopeless and advised against any treatment. Because of the experiences with Cases I and II it was felt that wide excision and grafting should be attempted although there was little chance of cure.

The series of operations carried out by the writer can be summarized as follows: February 2, 1944. Excision of strip of skin, fat, nodes and fascia 12 by 6 inches in size from Poupert's ligament to the knee over the outer half of the thigh with closure by a dermatome graft. One nodule was found in the sartorius muscle.

February 17, 1944. Excision of strip of skin, fat, nodes and fascia 12 by 5 inches.

The patient's general condition was never good but was improved by numerous transfusions. She was discharged on May 2, 1944. The pathological examinations by Dr. Warren revealed malignant melanoma in all specimens removed.

Comment—It is now three years since her last operation. She returned to her position as secretary and has worked ever since. She has never had any swelling of her leg. There has been no recurrence.

op to 1 cm were noted. These were thought to be extensions of the lesion in the lymphatic chain.

At Westfield wide removal of the skin with inguinal dissection was advised. This was not accepted by the patient. Three weeks later she was seen at another clinic and she was advised to have an amputation and a node dissection. She then consulted the writer again was referred to the Massachusetts General Hospital (Case No 393073) and was admitted there March 4 1943.

On March 6 1943 operation was done. A strip of skin fat and fascia measuring 3 to 4 inches in width was removed from the internal malleolus to the knee exposing the muscles. The mass overlying the tibia was removed down to the periosteum. The muscles were covered with dermatome grafts. Grossly the tumor appeared to be a malignant melanoma with secondary nodules in the subcutaneous tissue. The pathologist gave the same report but did not note the secondary nodules.

On March 24 a radical groin dissection was done. The saphenous and inguinal nodes were removed. Poupert's ligament was divided and the inguinal canal laid open. The lymph nodes along the iliac vessels were carefully removed. A segment of skin and fascia from Poupert's ligament to the knee was excised, making the removal of skin from the malleolus to the groin complete. The upper portion of the defect was closed by undermining the skin the lower by applying a dermatome graft (Fig 349). The deep nodes were reported as negative but three out of five superficial nodes contained malignant melanoma cells. She was discharged on April 11 1943.

She was readmitted on July 30 1943 with a recurrent nodule over the lower tibia at the site of the first secondary nodule. A portion removed for microscopic examination showed it to be positive. The remainder was destroyed by electrocoagulation and the underlying bone was also coagulated. Later the bone was removed as a sequestrum.

On November 5 1943 she returned for removal of another nodule over the inner aspect of the knee deep to the graft and apparently a nodule in the lymphatics left at the first operation. This was excised and was found to be positive.

Comments—This patient is one of a very few who has had successful treatment of a primary malignant melanoma by radiation. However

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during the second pregnancy there is no reason to think that they were influenced by the pregnancy.

CASE III—M A a 44 year old single female secretary was examined in the Tumor Clinic of the Massachusetts General Hospital on August 25 1942. She stated that she had had a mole on her right leg for several years and that for four months it had been getting larger. One physician had treated it by monopolar desiccation and when it recurred another had excised it. The pathologist reported

These patients are free from disease 13½, 3½ and 3 years later, respectively. In each case several operative removals were required before the lesions were completely eradicated.

There has been no permanent disability from the operative treatment.

It is too early to claim cures for the last two cases.

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Gradually her weight has increased to over one hundred. When last examined on April 3, 1947, her condition was excellent and the grafts were soft and pliable (Fig 351). Three years is too short a time to

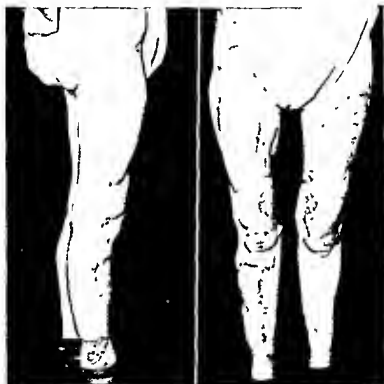


Fig 351 (Case III) —Three years after operative removal and replacement by dermatome grafts. Note the graft replacing the primary melanoma above right ankle.

call this patient cured, but her treatment has been very satisfactory palliation and cure is a possibility.

SUMMARY

Three cases are reported of malignant melanomas of the lower extremity spreading along the subcutaneous lymphatics and involving

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cancer can be induced in male mice by the hormone in a strain in which there is a mammary cancer in the female. Androgens significantly reduce the percentage of female mice of a highly susceptible strain, however, of either androgens or estrogens. Published breast cancer in the experimental alteration of sex hormones were equivalent. Changes were observed. Following the reports on effects on cancer of the prostate gland after orchiectomy, therapy, interest in the problem of hormonal alteration of cancer, especially those originating in sex organs, was intensified both here and abroad. As a result, a number of important observations have been made. It is not the purpose of this communication to attempt a comprehensive review of the data and it is premature to arrive at definite conclusions. Nevertheless, attention will be called to the possibilities and limitations of sex hormonal administration or deprivation in cancer of the breast.

It was natural, in view of the possibility of induction of cancer of the breast with estrogens, that androgens should be tried in the treatment of the disease. Early reports were apparently contradictory,⁶ but it was clear that significant alterations in the disease might occur after such therapy. In premenopausal women results were obtained that were akin to those seen after castration. This was not unexpected since biologically active androgens are capable of inhibiting the gonadotropic activity of the pituitary gland. As a consequence there was the possibility of a suppression of ovarian activity, i.e., medical castration. Of interest, however, is that effects were obtained in elderly women as well,⁷ suggesting that androgens may also exert their influence in other ways. Androgens are concerned with protein anabolism and osteogenesis. These activities may help to explain the changes seen in elderly women particularly. The mechanism of action

visual may improve considerably. In a significant number of patients there be possible acceleration of the These women or all ages, are very difficult to explain.

The administration of estrogens, on the other hand, to patients with advanced cancer of the breast may also produce striking alterations of the disease.⁸⁻¹⁰ The following changes may be seen in patients who

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HORMONAL ALTERATION OF ADVANCED CANCER OF THE BREAST

IRA T. NATHANSON, M.D., F.A.C.S.*

OBSERVATIONS in human beings together with animal experiments strongly suggest that the sex hormones are factors in the genesis and regulation of breast cancer. The pertinent data are reviewed elsewhere.^{1, 2, 3} Studies indicating that beneficial effects may accrue subsequent to castration in patients with advanced cancer of the breast have been of particular interest. Favorable responses, sometimes dramatic, are manifested by a relief of pain, improvement in the physical status, increase in hemopoiesis, apparent regression of osseous metastases and occasionally pulmonary metastases. An influence on the primary tumor or lymph node metastases is seldom noted following castration, but observations have been complicated by treatment of the soft tissue disease with x-ray or surgical procedures. Beneficial effects following castration are confined almost exclusively to premenopausal patients. Various studies up to the present indicate that from 15 to 30 per cent of premenopausal women with advanced current or metastatic breast cancer, may derive benefit from castration.^{4, 5} The procedure does not appear to be significantly advantageous when employed as a prophylactic measure as an adjunct to radical mastectomy in women whose disease is confined to the breast and regional lymph nodes.⁶ Thus it is the consensus of most observers at present, that castration should be reserved for premenopausal patients with advanced, recurrent or distant metastatic breast cancer. The question of the efficacy of surgical versus radiation castration will not be discussed here.

Additional information concerning the role of the sex hormones in cancer of the breast has been obtained from experimental studies in animals.^{1, 2, 3} For instance it has been demonstrated that ovariectomy results in a marked reduction in the incidence of spontaneous mammary cancer and delays the appearance of those tumors that arise in mice having a high susceptibility to the disease. Moreover, breast

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cancer can be induced in male mice by the hormone in a strain in which there is a mammary cancer in the female. Androgens significantly reduce the percentage of female mice of a highly susceptible strain, however, of either androgens or estrogens. Established breast cancer in the experiment alters the course of breast cancer in the castration of sex hormones were equivalent changes were observed. Following the reports on effects on cancer of the prostate gland after orchiectomy, the therapy interest in the problem of hormonal alteration of cancer, especially those originating in sex organs, was intensified both here and abroad. As a result, a number of important observations have been made. It is not the purpose of this communication to attempt a comprehensive review of the data and it is premature to arrive at definite conclusions. Nevertheless, attention will be called to the possibilities and limitations of sex hormonal administration or deprivation in cancer of the breast.

It was natural in view of the possibility of induction of cancer of the breast with estrogens that androgens should be tried in the treatment of the disease. Early reports were apparently contradictory⁶ but it was clear that significant alterations in the disease might occur after such therapy. In premenopausal women results were obtained that were akin to those seen after castration. This was not unexpected since biologically active androgens are capable of inhibiting the gonadotropic activity of the pituitary gland. As a consequence there was the possibility of a suppression of ovarian activity, i.e. medical castration. Of interest, however, is that effects were obtained in elderly women as well,⁷ suggesting that androgens may also exert their influence in other ways. Androgens are concerned with protein anabolism and osteogenesis. These activities may help to explain the changes seen in elderly women particularly. The most obvious effects are on the osseous metastases and the general condition of the patient. Pain may be dramatically relieved and the physical status of the individual may improve considerably. In a significant number of patients there is apparent recalcification in areas of osseous metastases. It must be pointed out, however, that in some instances there is an apparent acceleration of the osseous disease after androgen therapy. Regressions of the soft tissue disease do occur, but they are relatively infrequent.⁸ These variable and sometimes paradoxical effects which occur in women of all ages are very difficult to explain.

The administration of estrogens on the other hand to patients with advanced cancer of the breast may also produce striking alterations of the disease.⁹⁻¹⁰ The following changes may be seen in patients who

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The administration of estrogens on the other hand to patients with advanced cancer of the breast may also produce striking alterations of the disease.^{9, 10} The following changes may be seen in patients who

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 HQ) masses may significantly regress (Fig. 353), recurrent



Fig 352—Left Untreated carcinomatous ulcer in a patient aged 71 Right Epithelialization of ulcer after four months of stilbestrol therapy

skin nodules may disappear or become smaller edema and redness of the skin may diminish in intensity lymph node metastases may become smaller and regression of pulmonary metastases (Fig 354)



Fig 353—Left Fungating carcinoma in a patient aged 67 Right Appearance of original lesion after three months of stilbestrol therapy

may be observed Improvement in the general physical condition of the patient increase in appetite and weight and increased hemopoietic activity may occur In contrast to androgens favorable influences of estrogens on osseous metastases are relatively uncommon Improve ment from estrogen therapy in general is confined to patients over

60 years of age and is more obvious in older women. In a number of patients under this age particularly premenopausal women there is a suggestion that estrogens may accelerate the disease in others



Fig 354—Left Pulmonary metastases in a patient aged 57 Right Appearance of chest six months after diethylstilbestrol therapy



Fig 355—Left Untreated cancer of the breast in a male aged 58 Right Appearance twenty months after orchiectomy

usually menopausal women there is no apparent influence on the course of the process. Thus as far as the age of the patient is concerned these effects stand in contrast to those following castration

Cancer of the breast in the male is relatively rare and frequently the patient is first seen when the disease is considerably advanced. Hormonal alteration of males with advanced breast cancer has been dramatic.^{11, 12} Orchiectomy has led to changes that are as striking as those seen following the same procedure in advanced cancer of the prostate. Primary lesions and lymph node metastases significantly regress (Fig. 326), pulmonary metastases disappear as judged by x-ray examination and there may be calcification in the areas of osseous metastases. Relief from pain ensues rapidly, and the condition of the patient improves markedly. Estrogens have been used also, but the observations are confined to only a few cases. There is a suggestion that the hormone may favorably influence the tumor, but the changes appear to be less obvious than those seen after castration. When used subsequent to castration, they may have little or no effect but the number of patients is too small to make a definite statement regarding this. In contrast to the effect of castration on cancer of the female breast the best results are obtained in men 60 years or older.

COMMENT

These observations indicate that the administration or deprivation of the sex hormones may alter profoundly the course and character of advanced cancer of the breast in certain patients. The mode of action is subtle, especially since there is considerable variability of the effects in different patients even with the same form of therapy. The age of the patient may be a factor. It will be recalled that castration is effective primarily in premenopausal women, whereas estrogens are of the greatest benefit in elderly women. This suggests that the response of an individual with advanced breast cancer to estrogens or castration may be related to the state of activity in the ovary. The effects of the androgens, on the other hand, are not necessarily related to age, although there is a suggestion that young patients are more responsive to such therapy. Of interest also, are the various changes produced by the different methods of therapy. Castration and andro-

status of the host

The natural course of untreated cancer must be taken into consideration when evaluating the efficacy of any therapeutic method.¹³ At the present time, it is not possible to evaluate the role of these various methods in the prolongation of life of patients with breast cancer. These observations do not indicate that the administration or deprivation of hormones are in any sense a "cure" for the disease. Unfortunately, the patients who have an initial favorable response, eventually have a recrudescence of the disease process within months to a few years. Further hormonal therapy following reactivation usually offers little. In our opinion, however, use of hormones or castration may be

exceedingly effective as palliative methods, particularly when other therapy is not feasible. In many instances, the palliative effects are not maintained as long as those achieved by orthodox methods.

CONCLUSIONS

Evidence has been presented that the administration or deprivation of the sex hormones may influence the course and character of advanced cancer of the breast. These influences may be either favorable or detrimental. The methods employed are not in any sense a "cure" of the disease.

Beneficial responses have been obtained following estrogen therapy on the soft tissue manifestations of breast cancer, primarily in elderly women. Androgens on the other hand, may favorably influence osseous metastases in women of any age. Castration may affect osseous metastases in premenopausal women and most manifestations of the disease in older men. These responses are only temporary as reactivation is the rule.

The administration of sex hormones or castration in carefully selected patients may be of value as palliative measures when other methods are not feasible, or as an adjunct to the orthodox procedures.

These studies indicate that breast cancer may be dependent upon the endocrine status of the host. Thus, it appears that the validity of the classic concept of autonomy of cancer cells must be questioned. The fact that alterations occur in breast cancer following sex hormonal administration or deprivation should lead to intensive investigation regarding the mechanism involved. If this is kept foremost in mind, rather than the possibility that hormones may be a means of cancer therapy, progress can be expected.

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CARCINOMA OF THE BREAST

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RICHARD H. WALLACE, M.D., F.A.C.S.†

FOLLOW UP studies on patients with carcinoma of the breast have been carried out for over fifty years at the Massachusetts General Hospital. During this time there has been a progressive improvement in the results of treatment as shown in Table I.

TABLE I
CARCINOMA OF THE BREAST
MASSACHUSETTS GENERAL HOSPITAL
RESULTS OF RADICAL SURGERY

PERIOD	Percentage Cures
1894-1904	19
1911-1914	27
1918-1920	30
1921-1923	35
1924-1926	41
1927-1929	43
1930-1932	45
1933-1935	51

In the first series the cases were reported on a three year basis. Subsequent series have been followed from five to eight years, and untraced cases, or those living with recurrence, have been classed as failures. Patients who have died in less than five years of intercurrent disease without evidence of recurrence are considered as inconclusive. In the earlier series only those cases on the public wards were studied, but the recent series includes cases on the private wards as well. While a large number of surgeons have participated, and in recent years an increasing number of cases have been operated upon by the resident staff, the majority of the cases were operated upon by members of the Tumor Clinic staff of the hospital.

Operability.—During the years 1933, 1934 and 1935, there were 382 cases of carcinoma of the breast admitted to the hospital, of which 328 were primary cases while 54 had received treatment elsewhere and were admitted for treatment of recurrences. Ninety-two of the primary cases were considered inoperable when first seen, while

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236 were considered suitable for operation (72 per cent). Fourteen of these cases died of intercurrent disease within five years, and are omitted as inconclusive. Two patients were untraced and are considered as failures. The percentage of operability has fluctuated in different series, sometimes rising to 80 per cent and sometimes falling to 65 per cent or lower. This is due on the one hand to narrowed criteria of operability, and on the other hand to improved selection of cases referred by local physicians to the hospital. Carcinoma of the breast is operable while the disease is confined to the breast and axilla. The presence of fixation, massive involvement, satellite skin nodules or extensive ulceration contraindicates operation. The presence of matted or fixed axillary nodes also contraindicates operation. Metastatic involvement of the supraclavicular nodes or skeletal or pulmonary metastases are other evidences of inoperability. The mode of growth called inflammatory, also contraindicates operation. massive lymphatic blockade of

Any degree of skin involvement, large size of the primary tumor and the presence of multiple axillary nodes all augur a poor prognosis although they do not definitely rule out operation.

Individual surgeons vary in their acceptance of these relative contraindications to operation and may occasionally offer radical surgery even when it is recognized that the prospect for cure is remote. Review of the records of the initial findings suggested that there were twenty cases in which the disease was too far advanced to benefit from the operation which was performed. All twenty cases died of recurrence; seventeen of them within a year of operation.

Diagnosis—While the diagnosis of breast carcinoma is fairly certain in advanced cases, an increasing number of patients present themselves at a stage when the tumor offers no distinguishing characteristics. Immediate exploration of the tumor, with frozen section if necessary, was carried out in 116 cases in the present series. Axillary lymph node metastases were present in about half of the patients submitted to exploratory incision of the growth and it is probable that a greater number of explorations were performed than were actually required by the clinical findings. However, clinical appraisal of axillary nodes is notoriously fallible, especially in failure to recognize the presence of nodes which are actually already involved. The error in the clinical estimate of the axillary node involvement in the present series was 19 per cent. While immediate exploration of the tumor is ordinarily considered to be innocuous, provided proper precautions are taken, it was found that recurrence in the operative field took place in 15 per cent of these cases, as compared with 7.5 per cent of the cases not explored. This increased incidence of operative field recurrence may

be due to the relatively advanced stage of some of the explored cases, rather than to contamination of the field by exploratory incision.

Treatment.—Radical operation, with removal of both pectoral muscles and the axillary contents, according to the Halsted technic or the Greenough modification of Rodman's technic, has been employed throughout. We have not used preoperative radiation therapy. Post-operative x-ray therapy was used only when the surgeon felt he had left definite carcinoma behind or when the findings indicated a very poor prognosis. Radiation has been used extensively in the treatment of recurrences and in the treatment of the inoperable cases. Radiation castration was employed as an adjunct to the treatment of recurrent or inoperable carcinoma in young women.

Factors Affecting Prognosis.—*Age*—Several factors seem to bear a definite relation to the prognosis, of which the most important are the age of the patient, the preoperative duration, the size of the primary carcinoma, the presence of axillary metastases and the grade of malignancy of the tumor. Many of these are interrelated and it is difficult to evaluate the significance to attach to each one separately. Thus, the younger age groups are more likely to have tumors of higher grades of malignancy and are more likely to have axillary node metastases already established at the time of operation. It is probable that these two facts account for the poorer prognosis in the younger age groups. When the patients are divided into three age groups, cures were accomplished in 40 per cent of patients 20 to 40 years, in 50 per cent of patients 40 to 60 years, and in 65 per cent of patients over 60 years.

Duration—While historical data are unreliable, approximately 40 per cent of patients reported within two months of their first symptom, while 35 per cent delayed longer than six months. Cures were effected in 69 per cent of patients reporting within two months, 55 per cent of patients treated within six months and in 46 per cent of those who delayed more than six months.

Size—The size of the tumor correlates with the duration, the presence of axillary metastases and the grade of malignancy. Cures were effected in 89 per cent of the cases with primary carcinomas less than 2 cm. in greatest diameter, in 59 per cent of those 2 to 3 cm., in 41 per cent of those 3 to 4 cm., and in 18 per cent of those over 4 cm. in size.

Axillary Metastases—A factor of utmost importance in prognosis is the presence or absence of axillary metastases. While the total cures were 51 per cent, cures in patients without axillary metastases were 75 per cent, while in those with axillary metastases they were 33 per cent. The extent of axillary involvement is also of great significance. Thus large or multiple or matted nodes or involvement of axillary skin

are commonly considered contraindications to operation. On the other hand, when only one or two nodes are involved in metastasis the prognosis is nearly as favorable as in cases free from metastasis. While pathological data are incomplete in many cases, in 15 instances there was a definite statement of involvement of only one or two nodes. Twelve (80 per cent) of these cases were cured. If it is assumed that the remaining cases with axillary involvement presented multiple node metastases the cures in this group drop to 26 per cent.

Grade of Malignancy—It has long been recognized that the grade of malignancy, as shown by the histological character of the tissue, is of great significance in the prognosis. There is a correlation between the grade of malignancy and the age of the patient, the size of the growth and the presence of axillary metastases. Unfortunately, there are relatively few mammary carcinomas of the lowest grade of malignancy and these occur chiefly in the older age groups. In the present series, cures were effected in 100 per cent of cases of low grade malignancy, in 59 per cent of cases of medium grade, and in 37 per cent of cases of high grade of malignancy.

Operative Field Recurrence—The incidence of recurrence in the operative field or axilla in this series was 11 per cent. This incidence was greater in patients with high grade (18 per cent) or large (25 per cent) lesions, in those with axillary metastases (15 per cent) and in cases subjected to exploratory incision (15 per cent). It may be inferred that operative field recurrence may be a reflection on the technic of operation but also it may be attributable to characteristics inherent in the carcinoma itself. These recurrences rarely constitute the sole evidence of recurrence, more often they are part of a late

there were five postop

ulmonary complications
3st deaths and may be

minimized by appropriate preoperative measures

SUMMARY

Results in the treatment of carcinoma of the breast at the Massachusetts General Hospital have shown a consistent improvement.

In the present series, over half of the patients subjected to operation are living without evidence of recurrence from five to eight years after operation.

Factors of most significance in the postoperative prognosis are the age of the patient, the preoperative duration, the size of the primary carcinoma, the presence of axillary metastases and the grade of malignancy.

The same factors appear to be significant in relation to the incidence of recurrence in the operative field.

X ray therapy was employed in inoperable and recurrent cases, but only rarely prophylactically following operation. It cannot be demonstrated to have any effect on the prognosis as employed in this group of cases.

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THE SALIOGRAM IN THE DIAGNOSIS OF SWELLING ABOUT THE SALIVARY GLANDS

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A DEFINITE clinical diagnosis often cannot be made in patients presenting swellings in the region of the parotid or submandibular salivary glands. Any procedure, therefore, which will aid in diagnosis before subjecting the patient to surgery is of value.

Visualization of the duct systems of the salivary glands as a diagnostic aid has been advocated by many, beginning with Carls¹ in 1926. It has been periodically revived, and an extensive literature has been built up around it, including rather complete bibliographies published by Black and Hoeker² and Beyer.³

In the Tumor Clinic at the Massachusetts General Hospital, 125ialograms have been attempted, all but fifteen were successful. The failures were due either to inability to cannulate the duct or to loss of the opaque medium into the soft tissues, they occurred more frequently in attempted examination of the submandibular than of the parotid gland. The examination was carried out as an aid in the diagnosis of what was subsequently proved to be the following conditions:

Intrinsic tumors of the parotid	24
Tumors outside the salivary glands	20
Wittich's disease	3
Sarcoid	3
Xerostomia	3
Obstructive and inflammatory processes within the glands and ducts	20
Tobacco-stomach adenoma and other extrinsic disease	17
Diagnosis unknown, and unsuccessful examination	25

TECHNIC OF EXAMINATION

Sialography is easily carried out without much discomfort and with no harm to the patient. All of the patients experienced a sensation of

[illegible]

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or late resulted following the injection even in those few instances in which extravasation into the soft tissues occurred. A 2 cc Luerlock syringe and an attached No. 24 hypodermic needle with rounded point are used. No advantage is found in using a special needle with a bulbous tip. One to one-and-a-half cubic centimeters of warm iodized oil fills most of the parotid ducts well; slightly less is required for submaxillary visualization. Catheterization of the submaxillary is sometimes facilitated by slitting the end of the ampulla with a sharp instrument. Films of the parotid gland and duct are secured in three

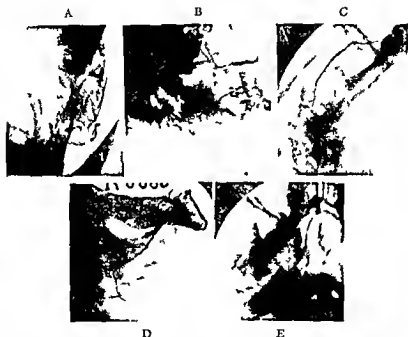


Fig. 356.—Normal sialogram. A Anteroposterior projection of the parotid gland and duct. B Lateral projection of same. C Frontosubmental projection of same. D, Lateral projection of submaxillary gland and duct. E Frontosubmental projection of same.

positions—the straight lateral, the anteroposterior and a frontosubmental projection of the submaxillary in two—a lateral and a frontosubmental. The lateral view is always taken last in order to avoid loss of the opaque oil. A small gauze pledget is pressed on the duct orifice after the cannula is removed until the moment of exposure. For the demonstration of displacement and deformation of the parotid gland and duct system the anteroposterior projection is found to be the most useful (Fig. 356).

RESULTS OF EXAMINATION

Tumors within the Gland—The characteristic roentgen finding of a mixed tumor of the parotid is displacement or deformity of the duct system so that the radicles appear to be spread, kinked or pressed upon by the tumor, but there is nothing to suggest destruction by infiltration. Stensen's duct and the smaller radicles may also show lateral displacement (Fig 357 A B C). These findings are observed, however, only when the tumor mass is of considerable size and cen-

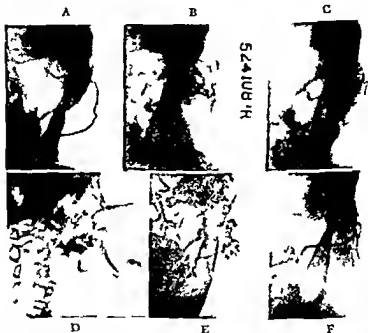


Fig 357—A B C, Anteroposterior projections showing displacement of gland radicles. D E F, Anteroposterior projections showing displacement of gland radicles.

trally located. In a few instances in which alveolar filling occurs the position of a small mixed tumor is shown by an area of diminished density in the "leaf tree" pattern (Fig 357 D E).

In eighteen patients with proven mixed tumor of the parotid, a defect by sialography was demonstrated in eight was questionable in four and in six no abnormality was found. Four patients with adenolymphoma (Warthin's tumor) showed no recognizable sialo-

graphic abnormality. Of two patients in whom carcinoma of the salivary glands was found the sialograms of only one showed a recognizable defect, and this defect was not notably different from what was shown by encapsulated tumors (Fig 357, F). Other investigators,^{1 5 6} however, have described characteristic findings in the presence of an infiltrating lesion such as carcinoma—destruction of the duct system and evidence of infiltration of the smaller structures of the gland rather than displacement by an expanding encapsulated tumor.

Tumors Extrinsic to the Gland—Twenty tumor growths outside the salivary glands were observed (four lipomas, two sarcomas, two

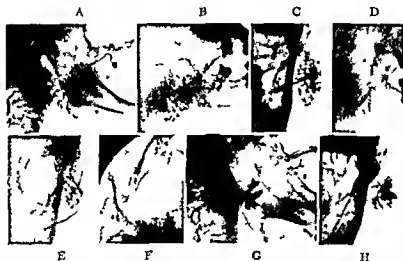


Fig 358—A Sialoangiectasis showing many small rounded collections of opaque material in dilated acini and normal duct. B C, Sialoangiectasis showing larger round cavities within the gland and irregularity and widening of the duct. D E F, Sialoangiectasis showing principally involvement of the intraglandular duct system. G H Parotid abscess.

lymphomas, two hemangomas, and ten metastatic tumors). Positive findings in the sialograms that is displacement of the gland and its duct system as a whole were seen in eight cases, were questionable in one, and were absent in eleven.

Mikulicz's Disease—Three cases of Mikulicz's disease were examined and in no case was any recognizable abnormality demonstrated.

Sarcoid—Three patients with sarcoid, in whom there was swelling of the parotid were examined and in none was any abnormality found. This has also been the experience of others.^{2 7}

Obstructive and Inflammatory Conditions—In twenty nine patients with persistent swellings due to inflammatory processes within the salivary glands or their ducts, or to obstruction by stone or stricture, the sialogram showed evidence of abnormality in all but one instance. In chronic parotitis the findings are somewhat reminiscent of what is seen in bronchiectasis of the lung. In one variety, the acini seem to have coalesced, and many small, sharply defined cavities are seen distributed throughout the substance of the gland. This has been called by Swinburne's *sialoangiectasis* (Fig. 358, A). Patients with this condition have recurrent bouts of swelling with some chronic enlargement, and may or may not have purulent discharge from the duct. In the presence of chronic infection, the small cavities may coalesce, and the duct system appears widened and irregular (Fig. 358 B, C, D, E, F). The characteristic roentgen findings are many globular collections of oil ranging from less than 1 mm. to 3 or 4 mm.



Fig. 359—A, B Obstructing stone shown by injected submandibular duct to be in the hilum of the gland. C, D Multiple strictures of parotid duct showing widening and "sausage" appearance.

in diameter, distributed over the substance of the parotid gland. In some presumably early cases or in those in which the infection is minimal, the ducts themselves are smooth, not displaced, and of normal width. More chronic cases show ragged and widened ducts. Multiple abscesses within the duct can be filled through the duct in most instances and appear on the roentgenogram as large, irregular cavities (Fig. 358 G, H). In swellings due to the presence of obstructing stones, the calculus can be shown in the duct (Fig. 359, A, B). Multiple strictures of Stensen's duct give the characteristic "sausage" appearance (Fig. 359, C, D).

Extrinsic Masses in the Neck.—In dealing with other masses in the neck, the roentgenologist must be careful to differentiate between the gland proper and the surrounding structures. The gland proper is usually well defined, and its position is usually in the lower neck, just above the clavicle. The surrounding structures, such as the thyroid gland, the trachea, and the esophagus, are usually well defined and have characteristic positions. The thyroid gland is usually in the upper neck, just below the larynx. The trachea is usually in the center of the neck, and the esophagus is usually to the left of the trachea. The roentgenologist must be careful to differentiate between these structures and the masses in the neck.

SUMMARY

1 Encapsulated expanding tumors within the salivary glands, if large or favorably placed, may be demonstrated by sialography. Small or peripheral tumors may not be recognized.

2 The recognition of malignant and infiltrating tumors as such has been disappointing at this hospital although other investigators report characteristic findings.

3 Extrinsic tumor masses may be shown by a displaced but otherwise normal gland or duct.

4 Swellings of the salivary glands due to Mikulicz's disease or sarcoid have shown normal sialographic findings.

5 Swellings due to inflammatory processes within the gland or duct, or due to obstruction by stricture or stone in the duct, almost constantly show characteristic findings.

CONCLUSIONS

The diagnosis of persistent swellings about the salivary glands may be enhanced by sialography. The procedure was found to be of the greatest value if the swelling proved to be of an inflammatory nature or due to chronic obstruction of a duct by stenosis or stone. New growths within the gland, if large or favorably placed, may be demonstrated but their nature may not be revealed.

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PORTAL HYPERTENSION

The Treatment by Splenectomy and Splenorenal Anastomosis with Preservation of the Kidney

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HEMORRHAGE from esophageal varices secondary to a portal bed block is a condition which has baffled the medical profession for many years. The recent articles on portacaval and splenorenal shunts by Whipple¹ and Blakemore and Lord² to reduce the portal hypertension in these cases, have stimulated a renewed interest in the subject. They have demonstrated the feasibility of shunting the portal blood flow directly into the systemic venous circulation by either a porta caval or a splenorenal anastomosis, thereby reducing the blood flow through the collateral venous channels in the esophagus and at the same time lowering the portal venous pressure. It is accepted generally that the esophageal varices are secondary to a partial block in the portal venous system. They represent collateral channels whereby the portal blood returns to the systemic venous circulation.

The normal venous pressure in the portal system with the patient supine is 8 to 10 cm. of water which is considerably higher than in the systemic venous system. Due to the portal bed block in patients

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Statistics are not yet available to estimate the relative frequency of the various types. First and probably the most common, is *intrahepatic* in origin. It results from portal or Laennec's type of cirrhosis. The flow of blood to the liver is obstructed secondary to the scar tissue replacement of the liver parenchyma. It probably is never completely occluded so that all the portal flow is forced through the collateral

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channels. However, a very large portion of it may be shunted. In this type of block the blood flow of the hepatic artery is added to that of the portal vein which passes through the collateral vessels. This opinion is based on the perfusion experiments on normal and cirrhotic livers by Herrick³ and later checked by one of the authors (R. R. L.). Herrick found that if the hepatic artery of a normal liver is perfused alone with the manometer attached to the portal vein that there is a 1 mm rise in mercury for every 40 mm rise in the hepatic artery pressure while in the cirrhotic liver there is a 1 mm rise for every 6 in the hepatic artery. He found in addition that the normal portal pressure was not affected until the arterial pressure was elevated over 100 mm while in the cirrhotic the portal pressure was affected as low as 30 mm.

The second type of portal bed block is *extrahepatic*. The obstruction is in the portal venous system before it enters the liver which as a rule is normal from a morphological viewpoint. The cause of the block is an occlusion of the portal vein or its main tributaries by fibrous or scar tissue which may be (a) congenital or (b) acquired. As Whipple⁶ has pointed out the former is believed to occur from the extension into the portal system of the obliterative process that takes place after birth in the umbilical vein and ductus venosus. This appears to be a plausible explanation for the occurrence of portal bed block with esophageal varices and splenomegaly seen in young children commonly diagnosed as Banti's disease or syndrome. The acquired form occurs probably as a result of venous thrombosis of the portal vein or one of its main tributaries. This process may develop in the splenic vein as was pointed out by Warthin⁵ in 1910. The thrombosis may progress proximally to involve the portal vein itself so that a main portal bed block develops. It is also within the realm of possibility that thrombi may break off from the splenic or other tributaries of the portal vein to produce portal embolism of the veins entering the liver. The etiology of portal venous thrombosis is less well understood than that which occurs in the lower extremities but that it exists there is not a question of doubt. It probably is the result of inflammation, trauma or it may be spontaneous developing as a result of phlebosclerosis. The thrombus undergoes organization and partial canalization but a permanent obstruction to the portal blood flow is produced which results in a persistent portal hypertension. A combination of the two main types, intrahepatic and extrahepatic, may occur in the same case.

Diagnosis.—A sudden massive hematemesis or severe melena is usually the first indication that a patient has a portal bed block. If roentgenological examination of the esophagus with barium shows esophageal varices the diagnosis is proven since no other condition produces these anomalous blood vessels. Further confirmatory evidence

as to the diagnosis is the presence of an enlarged spleen and blood examinations which show a secondary anemia, a leukopenia and a thrombocytopenia. The site of the portal bed block can usually be determined by liver function tests. A high retention of bromsulfalein

these liver function tests are normal the block is most likely extra hepatic.

Choice of Operation—There is some question yet as to which shunt operation is the best. Whipple⁶, Blakemore and Lord¹ and Blalock⁷ seem to favor a portacaval type since this produces the most complete shunt of the portal blood and at the same time a maximum reduction of the portal hypertension. Our opinion on the other hand is that a splenectomy with an end to side splenorenal shunt preserving the kidney is the better procedure. This type of operation serves two purposes. First it removes the spleen and thereby reduces the portal blood flow by as much as 40 per cent if there is a marked splenomegaly. Second it permits an anastomosis to be performed between the cut end of the splenic vein and the side of the renal vein without sacrificing the kidney. This shunt will reduce the hypertension by permitting some of the portal blood flow to enter directly into the systemic venous circulation but at the same time it will not cause all the blood to by pass the liver as in the case of a portacaval shunt. It has seemed to us in view of the nutritional difficulties encountered in animals in which a complete Eck fistula has been produced that the complete shunting of the portal blood by portacaval anastomosis should be avoided if the other type will reduce satisfactorily the portal hypertension.

REPORT OF FIVE PATIENTS TREATED BY SPLENECTOMY AND SPLENORENAL ANASTOMOSIS WITH PRESERVA TION OF THE KIDNEY

left renal veins with preservation of the kidney utilizing a thoraco-

operation described in this report eliminates the necessity of sacrificing the kidney. It is believed also that the end to side anastomosis is less likely to become blocked from thrombosis than the end to end

type since the blood from the kidney flowing through the renal vein has a suction effect on the blood entering it from the splenic vein thereby helping to maintain the patency of the anastomosis. Blalock² reports experimental evidence to support this opinion. A suture anastomosis was performed in these cases instead of the nonsuture type.

Technic of Operation—The patient is placed on the operating table lying on the right side so that his back is at about a 60 degree angle with the table. The anesthetic is ether administered through an endotracheal tube so that positive pressure may be maintained with an open chest and also to facilitate the administration of oxygen as well as the anesthetic. A vein in the left arm is cannulated before the intravenous administration of fluids and blood during the operation. A large bore needle such as a 16 gauge is preferable so that blood may be administered rapidly since severe and sometimes rapid hemorrhage may occur during the operative procedure because of the tremendous collateral blood supply encountered in the operative field. An additional precaution which has been found to be of great value in some of the cases is to have autotransfusion sets available in order that any large amount of blood which may escape during the operation can be saved and utilized for transfusion purposes. In one of the patients reported (No. 2) twelve transfusions were given during the operation, six of these being autotransfusions.

A thoracoabdominal type of incision first used by Sweet⁴ in this type of case is made over the tenth left rib from its angle posteriorly extending anteriorly through the abdominal wall to the midline cutting across the external internal oblique and rectus muscles. The tenth rib is resected subperiosteally and the pleural and peritoneal cavities are opened. The anterior portion of the diaphragm is divided in the line parallel to the incision to permit a direct exposure of the posterior attachments of the spleen. Once the incision has been completed the spleen if enlarged practically fills the operative wound. It is retracted forward to expose its posterior peritoneal attachments, the lienorenal and the phrenicocolic ligaments. These structures frequently contain enormous venous collateral channels so that they are best doubly clamped before dividing them. The gastrosplenic ligament and the vasa brevia are divided next leaving the spleen attached only by its pedicle. The dissection in this order is important since it gives the best access to the splenic vein which if injured may jeopardize this structure so that a satisfactory length of it may not be available for the venous anastomosis.

The splenic artery is isolated then divided and ligated proximal to the point it divides at the hilum. The spleen is gently compressed to evacuate as much blood from it as possible before dividing the splenic vein. This vessel is ligated and divided as close to the hilum as possible so that sufficient length of it will be available to make the

anastomosis The splenic flexure of the colon is retracted downward after the removal of the spleen and the tail of the pancreas is displaced anteriorward The peritoneum over the kidney is incised and this organ is completely mobilized from the perirenal tissues The renal artery is isolated proximal to the point it bifurcates so that a small bulldog arterial clamp may be placed on it to control the arterial inflow to the kidney while performing the venous anastomosis This is important, otherwise the kidney may be damaged from the high venous back pressure while the renal vein is occluded

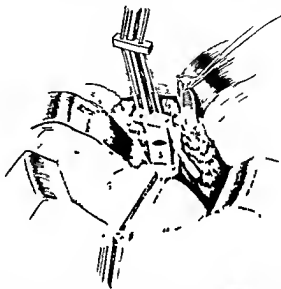


Fig 360—Schematic drawing to show the exposure of the (1) splenic vein, (2) renal artery (3) renal vein, (4) left kidney The renal artery has been clamped with a bulldog arterial clamp and the renal vein with two tourniquet clamps The ligatured end of the splenic vein is resected after applying a bulldog clamp to it, which controls the blood flow while performing the anastomosis

Sufficient length of the renal vein must be dissected next to allow

for a bulldog clamp so that there is an overlap between

control of the renal vein that have been used are a modification of the Bethune lung tourniquet clamp (Fig 360) Since the splenic vein lies slightly cephalad and anterior to the renal vein the anastomosis is performed between the end of the splenic vein and the antero-superior surface of the renal vein A transverse incision is made in the

latter the length of it is judged so that it will approximately equal the diameter of the splenic vein

The anastomosis is performed with No 5-0 braided silk on a No 9 needle. A continuous mattress type of suture is used everting the cut edges of the blood vessel walls so that intima is approximated to intima. The suture line is interrupted at three equidistant points by tying it to stay sutures in order to prevent narrowing of the anastomosis lumen from a purse string effect. The clamps on the renal vein and the one on the splenic vein are first removed after completion of the anastomosis. The hemostasis of the suture line is determined following this step. Occasionally a bleeding point may need a single suture to control it. The patency of the anastomosis may also be observed. Finally the clamp on the renal artery is removed (Fig 361)



Fig 361—Schematic drawing to show the completed end-to-side splenorenal anastomosis. All the clamps have been removed. 1 Splenic vein 2 renal artery 3 suprarenal vein 4 spermatic vein 5 renal vein 6 left kidney

The kidney is then placed back in its fossa and the peritoneum over it resutured.

thoraco abd
absorbable

Venous pressures are taken with a water manometer by cannulating one of the veins in the greater omentum before carrying out the splenectomy. A marked elevation above the normal was found in the cases reported in this article. The measurement is repeated after splenectomy to see the effect produced by the reduction of the portal pressure. also

group of patients have been very encouraging. The mortality rate has

PORTAL HYPERTENSION FIVE CASES OF LIVER PATIENTS WITH PRESERVATION OF THE KIDNEY
TABLE I

Patient	Age	Sex	Initial symptoms	Duration of symptoms	Previous Treatment	Portal Pressure in Constricture of Vein			Date of Operation	Time since operation without bleeding
						Initial	Post-operative	Post-anastomosis		
1 M J M	6	F	Hematemesis	10 wks	None	49.0			6/4/46	10 mos.
	30	M	Hematemesis	11 yrs	1937—Ligation of renal artery to continuity and anastomosis 1937—Ligation of left iliac and right coronary veins 1942—Transverse aortic ligation peritoneal varices 1946—Portacaval anastomosis attempted Cholecystectomy and cholecystectomy	33.5		21.5	6/8/46	
2 W M J N	63	M	Normal in vein	1 day	None	23.0			6/8/46	10 mos
	45	F	Hematemesis	5 mos.	None	34.5	31.0	14.0	1/11/47	3 mos
	23	M	Hematemesis	6 yrs	None	42.0	33.0	26.0	2/7/47	2 mos
								24.0	3/13/47	4 wks

been zero none of the patients has bled from the esophagus or the gastrointestinal tract since the operation except one patient (No 3) who had a hematemesis on the first and fourth postoperative days. This may have been due to an unlying nasal tube that was placed in the stomach prior to the operation by error and removed at the end of twenty four hours. It is still too early to be sure that all dangers of bleeding have been eliminated in these patients since the longest follow up is only ten months in two cases. The patients will have to be followed for a number of years to be sure that the portal pressure has been reduced permanently so that the load has been taken off the esophageal veins. In the cases that have had portal pressures taken before and after the splenectomy and splenorenal anastomosis there has been a gratifying drop in the level (Table 1).

No deleterious effect to the kidney in any of the patients has been demonstrable as the result of interrupting its blood supply while performing the splenorenal anastomosis. The longest period of interruption was thirty five minutes. An interesting observation has been made in this group of patients to the effect that portal hypertension per se is not the cause of ascites as none of the patients in this group had ascites at the time of operation. The anticoagulant heparin was used in the form of Pitkan Menstruum heparin in one case (No 1). Despite the fact that careful coagulation time determinations were made at frequent intervals this patient developed a marked hemothorax and hemothorax. It is believed that due to the magnitude of the operation and the tremendous number of blood vessels encountered in the operative procedure anticoagulants should not be used despite the fact there would be a better chance that the anastomosis would remain patent if they were used. Studies are planned in the future to try to determine whether the —

The only evidence we have at is that none of the patients has from the hospital

CONCLUSIONS

- 1 Hemorrhage from esophageal varices is secondary to a portal bed block and an associated portal hypertension. The block may be either intrahepatic or extrahepatic.

- 2 Five patients with an extrahepatic type of block are reported in whom a splenectomy and an end to-side splenorenal anastomosis with preservation of the kidney have been performed.

- 3 The results of the surgical treatment have been encouraging since none of the patients has bled from the gastrointestinal tract since discharge from the hospital.

- 4 The longest follow up is ten months in two patients so it is too early yet to claim permanent relief.

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POSTTHROMBOTIC SEQUELAE OF THE LOWER EXTREMITY TREATMENT BY SUPERFICIAL FEMORAL VEIN INTER- RUPTION AND STRIPPING OF THE SAPHENOUS VEINS

(A Preliminary Report)

ROBERT R. LINTON, M.D., F.A.C.S.,* AND IRAD B. HARDY, JR., M.D.†

THE treatment of changes in the lower leg secondary to deep thrombophlebitis is a problem which has long baffled the medical profession. Earlier attempts at therapy have been directed at the correction of the local ulceration if present and the varicose veins which usually follow the episode of thrombosis. Many of the poor results in the past were no doubt due to the lack of knowledge concerning the physiopathology of these conditions. A distinction should be made between simple varicose veins of the superficial saphenous systems which may at times be complicated by ulcer, pigmentation and edema and the more complicated problem which develops when these abnormalities follow an episode of deep venous thrombosis. In the latter the deep veins have recanalized with consequent incompetence of their valves and the valves of the communicating veins. Homans¹ in 1916 pointed out the importance of this fact and recommended the interruption of the communicating veins in the lower leg in the treatment of varicose veins secondary to deep thrombophlebitis. Edwards and Edwards² have reported the degeneration of the venous valve in deep thrombophlebitis with subsequent canalization of the vein. As contrasted with patients with normal deep veins and competent valves the venous pressure in patients in the erect position who have had a previous deep venous thrombosis remains constantly elevated during walking. This had been demonstrated by Beecher³ who has also with other workers⁴ shown the increased tendency to edema formation in the postthrombotic extremity.

Homans¹ recommended excision of the postthrombotic ulcer with subsequent skin grafting in conjunction with removal of the varicose veins. Lumbar sympathectomy has been performed in our clinic to

eradication of the varices of the superficial system. Linton⁵ has de-
eg but has been dis-
Operative interrup-
been combined with

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scribed a procedure which accomplishes this in the lower leg with good results in about 50 per cent of the cases. The role of incompetent communicating veins has been recognized for many years. Trendelenburg⁶ popularized the test that bears his name. It may be utilized to determine competency of the valves in the superficial, communicating and deep system of veins. The *Trendelenburg test* is performed on the postthrombotic patient in our clinic as follows:

The patient lies down on the examining table and the extremity is elevated to empty the varicosities of blood. A tourniquet is applied below the knee occluding only the superficial veins. The patient then assumes the erect position. If the superficial varices then fill within a few seconds with the tourniquet still in place, the valves of the deep and communicating veins are incompetent whereas if the filling is very slow they are considered to be competent. Interruption of the superficial femoral vein is indicated in the former but not in the latter in our opinion.

Interruption of the femoral vein distal to the profunda femoris vein in the treatment of thromboembolic disease has been shown to be a safe procedure. In the past eight years at the Massachusetts General Hospital, 1692 patients have had one or both femoral veins interrupted. This series represents 3185 vein interruptions without a single serious complication. There are no reported statistics on the incidence of postthrombotic changes in these individuals but it is believed that ulcer, edema and varicose veins rarely have developed. Buxton and his associates⁷ in 1944 and again Buxton and Coller⁸ in 1945 reported a series of twenty four cases of long standing phlebitis with its associated changes which were treated by interruption of the femoral vein and ligation of superficial varices in some cases with beneficial results in the majority of the patients. Homans⁹ has recommended also the interruption of the canalized sclerosed femoral vein in the postthrombotic states.

REPORT OF THIRTY FOUR CASES

The purpose of this article is to report a series of thirty four patients from the Massachusetts General Hospital with postthrombotic changes in the lower extremity who have undergone long saphenous vein interruption and stripping combined with the interruption of the femoral vein distal to the profunda femoris vein. In addition some of the patients have had short saphenous interruptions and strippings. All the operative procedures were performed by the authors. The postoperative care also was carried out by them.

There were twenty females (59 per cent) and fourteen males (41

1

and eight were associated with severe infections such as pyemiasis. A definite history of phlebitis could not be elicited in three instances.

but the clinical picture left little doubt as to its pre existence. The history of bilateral phlebitis could be elicited in only twelve cases but both extremities were operated on in twenty four cases because the Trendelenburg test revealed incompetent deep and communicating veins in all of them. This discrepancy was due either to faulty memory of the patient or to a subclinical episode of phlebitis on one side with the development of late postthrombotic changes. Thirty three of the thirty four patients had varicose veins which gave symptoms. Twenty four complained of edema. Ulceration was present in twenty one cases. Pain was an outstanding complaint in twenty two instances. The Trendelenburg test was performed on all the extremities with the tourniquet just below the knee. The veins filled rapidly from below in all cases indicating incompetent communicating and deep veins. Six of the thirty four patients had had previous high saphenous vein interruptions and despite this all of these patients had ulcerations when first seen. Seven other patients had had previous procedures with only temporary or no improvement.

Preoperative Care—The open ulcerations were healed in eight of the patients before hospitalization with bland ointments and elastic

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of

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wt

with open ulcerations operation was delayed until the ulcers were healed. Preliminary split thickness skin grafts were applied to large ulcers in one case with bilateral ulcerations.

Operative Procedures—Penicillin was administered preoperatively to all patients with recent ulcerations or extensive skin changes and continued for five days after operation. Gas oxygen ether was the anesthesia of choice. The patients were draped to allow exposure of the entire leg and groin but skin towels were used to protect all the groin wounds. The groin incisions were made parallel to the femoral pulsations since adequate exposure of the blood vessels more than compensated for the slightly neater healing of oblique incisions. The superficial femoral vein was exposed just distal to the profunda

The saphenous

the superficial
femoral vein distal to
ing it temporarily with
addition with the loric
measurements were obtained with a spinal fluid manometer using a
three way stopcock and normal saline in the manometer. The initial
pressure in the superficial femoral vein was found to average between
4 and 10 cm. of saline. After occlusion of the superficial femoral vein
with the stay ligature the pressure in the femoral vein rose slightly to

a level of between 8 and 14 cm of saline. Occlusion of the saphenous vein in addition produced a further rise of the venous pressure to between 12 and 20 cm of saline. Venous pressures above 30 cm after occluding both the superficial femoral and long saphenous veins are a contraindication to stripping the saphenous vein at the time because extensive bleeding may occur from the tributaries of this vessel. In one patient, because the pressure rose above this level after occluding the femoral vein, the stripping of the long saphenous vein was delayed for several days when the venous pressure had returned toward normal. If the pressure rises above this level after occluding only the femoral vein it should not be interrupted. In such a case the surgical procedure should consist only of ligation and stripping of the saphenous vein or veins. The importance of obtaining these pressure readings cannot be overemphasized since serious complications may be pre-

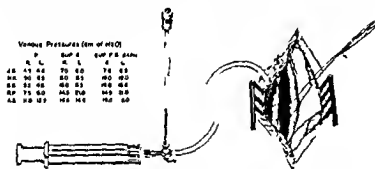


Fig. 362.—Diagrammatic sketch showing the method of ascertaining venous pressures in the superficial femoral vein. The chart shows actual determinations.

vented by limiting the venous interruptions to either the saphenous vein or the superficial femoral vein rather than both vessels when the

which vein
Trendelen
us pressure

determinations

The femoral veins were divided the ends doubly ligated and stitched just distal to the profunda femoris vein. Specimens were taken of the vein in many instances to demonstrate the process of canalization which has been found to occur in all the cases (Fig 363). The amount of periphlebitis and the degree of canalization of the vein varied considerably in the different patients. The saphenous vein was then divided and followed proximally to the sapheno-femoral junction care being taken to divide all branches. It was

ligated at its junction with the femoral vein. The distal segment of the saphenous vein was then stripped to the medial malleolus of the ankle using an intraluminal type of stripper. Additional incisions were made sometimes in the region above or below the knee to complete the stripping. It is believed that the complete removal of the long saphenous vein from the groin to below the internal malleolus is necessary especially if the patient has an ulcer on the inner side of the lower leg. Despite the chronic inflammation and fibrosis of the skin and subcutaneous tissues in these cases it was found that the saphenous vein stripped with ease even beneath an ulcer area. Care was



Fig. 363—Microphotograph of cross section of superficial femoral vein showing marked thickening of vein wall and canalization.

taken in exposing the vein at the ankle not to damage the saphenous nerve.

The entire procedure was done bilaterally in twenty-four patients. A unilateral operation was done in eight patients where the postthrombotic changes were confined solely to one leg. A bilateral femoral interruption was combined with a unilateral saphenous stripping in one patient, the femoral interruption on the one side being considered a prophylactic measure against thrombosis. One patient who had bilateral varices but postthrombotic changes in only one leg underwent a unilateral femoral vein interruption combined with bilateral saphenous vein strippings. When short saphenous varices

were present or were suggested by induration or recent ulceration over the lateral aspect of the ankle the short saphenous vein was stripped from the ankle to the popliteal space. This procedure was done on four patients. Five other patients had, in addition to their femoral vein interruptions and long saphenous stripplings, interruption of the short saphenous vein in the popliteal space. Pressure bandages were applied after closure of the wounds. The patients were kept on low shock blocks for twenty-four hours and then were allowed up to walk. The pressure bandages were removed in forty-eight hours. During their hospital stay the patients were not allowed to sit for long periods. The patients were hospitalized from six to twenty-eight days, the average time being twelve days. However, half of the patients were home in ten days or less. Elastic bandages or stockings were worn by most of the patients for several weeks or until the postoperative edema subsided.

TABLE I

FOLLOW-UP (2 TO 14 MONTHS) OF THIRTY-FOUR PATIENTS WITH POSTTHROMBOTIC CHANGES MASSACHUSETTS GENERAL HOSPITAL, 1946

A. Twenty-one Patients with History of Ulcer	
Healed before admission	8
Open on admission	13
Remained healed since operation	20
Recurred	1
B. Edema	
Preoperative	21
Edema improved postoperatively	14
Edema present postoperatively	10
No preoperative edema	10
No edema postoperatively	9
Postoperative edema	1
C. Varicose Veins	
Preoperative	34
Improved postoperatively	34
Injecting postoperatively	10
No injections	24

Complications—There were four patients who developed marked edema in one leg which was believed to be secondary to postoperative deep venous thrombosis. The swelling in all the cases gradually disappeared with elastic supports. Sepsis of a minor degree developed in one wound. Two patients had reactions from penicillin. They recovered rapidly following discontinuation of the drug. One patient

to fourteen months. Twenty-one patients had a history of ulcerations. Twenty ulcers have remained healed since operation. There has been one superficial recurrence in this group. There are fourteen patients

who have had considerable improvement in the edema in a group of twenty four with swelling preoperatively Ten patients have some edema but no more than before operation Thirteen of these twenty-four are wearing some support in the form of elastic bandages and stockings Only one patient in the group of ten people without pre-operative edema has developed swelling since operation Ten of the thirty four patients had postoperative injections done in the office to eliminate persistent small varices Twenty four have required no injections

SUMMARY AND CONCLUSIONS

1 The treatment of postthrombotic changes of the lower extremity (ulcer, varicose veins and edema) has been unsatisfactory in the past because of the high percentage of recurrence

2 A combined operation is reported consisting of ligation and stripping of the saphenous veins and interruption of the incompetent canalized deep venous system by the division of the femoral vein distal to the profunda femoris vein.

3 Thirty four cases have been treated by this method with encouraging results. Twenty of the twenty one ulcerations have remained healed. Edema has subsided in the majority of cases.

4 The longest period since operation without recurrence of pre operative ulcerations is fourteen months which is encouraging but still too short a time to speak of as a cure in this condition

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TABLE 1

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A Twenty-one Patients with History of Ulcer	
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C Varicose Veins	
Preoperative	34
Improved postoperatively	34
Injections postoperatively	10
No injections	24

Complications—There were four patients who developed marked edema in one leg, which was believed to be secondary to postoperative thrombosis. The swelling in all the cases gradually subsided. The degree developed was mild to moderate. They received penicillin. They received no other drug. One patient required vein stripping.

Two patients were followed from two to four years. There has been no recurrence of ulcerations. There has been no recurrence of edema in fourteen patients.

The necessity for a wide excision is clear, because the tendency of these nerves to regenerate is now well known. At a secondary operation performed in this hospital for relief of recurrent abdominal pain a regenerated splanchnic nerve was found which had connected with the celiac ganglion after resection carried above the diaphragm. The work of Grimson⁷ has shown that some regeneration, at least of the sympathetic fibers to the sweat glands takes place even after total sympathectomy, but it is much less than after operations of limited extent. The most complete and lasting denervation of the adrenal glands is particularly desirable, as the experiments of White, Okelberry and Whitelaw³ have suggested that any return of adrenal secretion causes extensive recurrent vasoconstriction of the sensitized smooth muscle of the arterioles in the denervated area.

In the second place there is a selected group of patients in whom the dorsal sympathetic chain should be removed to an even higher

TABLE 1

THORACOLUMBAR SYMPATHECTOMY FOR HYPERTENSION
100 Consecutive Procedures, 1916-1947

Type of Operation	Number of Operations	Average Extent	Complications	
			Pain	Pleuropulmonary
Smithwick	39	D ₁ -L ₂	13%	2%
High paravertebral	14	D ₁ L ₁	14%	14%
Transpleural	35	D ₁ L ₁	23%	11%
Peet	12	D ₁ D ₁₀	16%	25%

Mortality = 0

level. When it is necessary to eliminate hyperhidrosis of the face and upper extremities when the symptoms of Raynaud's disease are present in the hands or if tachycardia is a prominent symptom, it is well to carry the excision of the dorsal chain to the second dorsal ganglion.

Consequently only in the poorer risk patients do we use the more limited operations of Peet,⁴ or that described by Smithwick³ and recently modified by one of us.⁶ Two methods, a more extensive dorsal approach and a transpleural approach are now in use in our clinic, and will be described in this paper. That these more formidable procedures can be carried out without undue risk is shown in Table 1.

Somewhat similar procedures have been used by other surgeons. Poppen⁷ employs an extensive dorsal approach, while transthoracic operations have been described by Grimson⁸ and by Hinton and Lord.⁹ Grimson resects portions of both the third and tenth ribs but

THORACOLUMBAR SYMPATHECTOMY FOR HYPERTENSION

Improvements in Paravertebral and Transpleural Routes to Facilitate Extensive Neurectomy

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be in order to be effective. Several considerations have a bearing on this problem and have been useful in guiding our policy as to the extent of the operation to be performed.

In the first place as Simeone, Cannon and Rosenblueth¹ have shown, a sympathectomy, to be effective, must be complete. Since it can be demonstrated anatomically that vasoconstrictor fibers may reach the abdominal viscera over connections which often leave the major splanchnic trunks as high as the sixth rib and descend along the aorta and esophagus, a sympathectomy should extend as high as the sixth dorsal ganglion. The delicate rami, which leave the major splanchnic nerves and descend along the aorta and esophagus, can be interrupted in no other way than by high resection of the splanchnic trunks. They have been shown most clearly in anatomical photographs sent us by Professor G A G Mitchell of Manchester. According to him splanchnicectomy to the sixth rib should remove all connections which pass through the diaphragm. If a maximal postural hypotension is desired, the lumbar chain should be removed below the third lumbar ganglion, since we have seen a few cases where slight degrees of sweating persist in the legs after resections stopping at the second lumbar ganglion. As excisions of both ganglionated chains to this level will stop the ejaculations of semen, the lumbar chain should be left intact on one side in male patients who wish to have children.

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With the lateral surface of the vertebral column freed of pleura above the diaphragm up to the sixth rib, and of renal fascia and peritoneum below it down to the level of the iliac crest, the diaphragm is divided down to the sympathetic chain, leaving a narrow cuff of

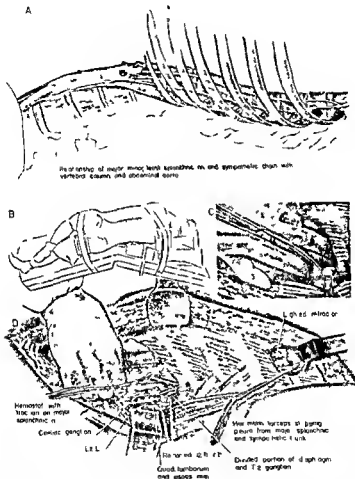


Fig 364—Technic of extensive thoracolumbar sympathectomy by paravertebral extrapleural route (see text)

muscle attached to the vertebrae for subsequent suture. This step is facilitated by inserting the index finger of the left hand on one side of the arcuate ligament and the middle finger on the other side to identify it (Fig 364, C). Thus a clear exposure of the sympathetic chain and splanchnic trunks is gained.

makes no formal attempt to section the diaphragm. Hinton and Lord do a retropleural dissection, but open the diaphragm widely. The variations in our technic will be apparent from descriptions that follow.

PARAVERTEBRAL APPROACH WITH PATIENT IN LATERAL POSITION AND RESECTION OF CENTRAL PORTION OF EIGHTH AND TWELFTH RIBS

Endotracheal anesthesia is used in order to control the respiration if the pleura is opened. The patient is placed on his side in the position shown in Figure 364, B. A cushion supports the chest. The upper thigh and knees are flexed and supported by pillows placed between the legs to relax the psoas muscle. A webbed belt and broad bands of adhesive will support the patient in the correct position. The table is then broken in the middle in order to gain the greatest possible space between ribs and iliac crest.

The paravertebral incision is a long one, starting at the level of the sixth rib and continuing parallel and 5 cm. lateral to the spinous processes down to the midlumbar region, where it is curved laterally to the middle of the iliac crest. To expose the ribs, fibers of the trapezius, latissimus dorsi and serratus posterior inferior muscles are cut. In the lumbar region the lumbar fascia is exposed. The central

vated and bent slowly backwards 90 degrees, in which position it is held by a loop of gauze clamped to the drapes with a towel clip (Fig. 364, C). Secured in this fashion it serves as a useful retractor. (After being used in this way the rib should be cut off at the time of closure.)

The next step is to divide the lumbar fascia, separate the abdominal from the posterior longitudinal muscles, and free the renal capsule and peritoneum from the quadratus lumborum and the psoas. This is done by blunt finger dissection with special care to free the space under the diaphragm down to its medial arcade. At this stage the twelfth intercostal and first lumbar nerves are encountered as they arch across the incision. If possible, it is best to preserve them intact, but the surgeon must bear in mind that excessive traction on these structures may lead to severe postoperative radicular pain. Sometimes it is better to cut a nerve than to preserve it overstretched. The kidney and

the neurectomy can be confirmed by a postoperative roentgenograph of the thoracolumbar spine. In removing the lumbar portion of the chain, precautions must be taken not to damage the ureter, the genitocrural nerve, or the renal vessels. The lumbar veins sometimes arch over the trunk and may bleed profusely if injured.

When the neurectomy has been completed the cut fibers of the diaphragm are sutured with cotton or silk. The pleura which has been widely detached tends to remain collapsed. To secure re expansion of the lung a catheter should be left in the retropleural space and another within the pleura if it has been opened. The anesthetist is then requested to apply increased intratracheal pressure as the muscles and fascia of the back are sutured. All air is then removed by is withdrawn while suction is interrupted sutures of fine silk minutes longer than the older method of removing the eleventh and twelfth ribs, but it permits a far wider and better exposure of the sympathetic and splanchnic trunks and is well tolerated. As a rule, the patients are able to get out of bed on the fourth to seventh postoperative day, and are ready for the second stage in a week or ten days. It has been used routinely on the neurosurgical service for the past year, and has been popular with our residents who comment that it is much easier to perform a high neurectomy if, along with the twelfth rib, the eighth rather than the eleventh rib is removed. Operation in the lateral position permits a much better exposure of the lumbar ganglia than the prone position in which the lumbar chain may be obscured by a tense and bulging psoas muscle.

TRANSPIEURAL THORACOLUMBAR SYMPATHECTOMY

After induction of endotracheal ether anesthesia, the patient is placed on his side in the usual thoracotomy position. A tilt table will facilitate the exposure, since the position of the patient may be changed during the operation. The surgeon which high pref-thetic y be-tween them a vertical incision is made through the posterior pleura and endothoracic fascia. The pleura and endothoracic fascia are reflected. The various connections between the sympathetic and the great splanchnic nerve, and the lesser and least splanchnic nerves, if present, can all be identified with ease and with precision. Either the upper or lower portion of the dissection may be performed first. If the dissection is begun with the dorsal portion, the greater splanchnic

The next step is to proceed with the actual neurectomy (Fig 364 D) The major splanchnic nerve is elevated with a nerve hook and freed by blunt dissection It is divided a centimeter or two below the diaphragm where it expands into the celiac ganglion The distal end is clamped with a dural clip, cut and then enclosed with a silk or a tantalum cylinder as described by White and Hamlin,¹⁰ in the hope that regeneration may be avoided The dissection is then carried upward and is facilitated by the use of lighted retractors The minor and least splanchnic nerves are usually seen running parallel to the major trunk and are resected at the same time The major splanchnic nerve is usually found to join the sympathetic chain at the level of the sixth vertebra At this point it is clipped and cut and its entire length removed

By the time the splanchnic trunk has been resected the more superficial chain of the thoracic ganglia should be clearly in view as it loops over the heads of the ribs The chain is picked up on a nerve hook and released by identifying and cutting the communicant rami which anchor the ganglia to the intercostal nerves These are first clipped with dural clips in case an intercostal vessel be severed by mistake When the chain has been freed to the sixth rib and cut off, the dissection is carried downward It should include the rami to the minor and least splanchnic nerves which arise from the lowest thoracic ganglia It will be found that the upper exposure through the bed of the eighth rib permits the surgeon a far better view than the older method of removing the eleventh and twelfth ribs

Following this complete removal of the sympathetic chains and splanchnic nerves from the lower half of the thorax the neurectomy is carried downwards Exposure of the lumbar ganglia is much easier with the patient on his side than in the prone position, since the sympathetic chain swings to a more anterior position between the twelfth thoracic and first lumbar segment

The lumbar chain lies on the anterolateral aspect of the lumbar vertebrae at the mesial edge of the psoas muscle, under the edge of the vena cava on the right and the aorta on the left It can be palpated and feels like the vas deferens in the spermatic cord The first ganglion lies beneath the crus of the diaphragm and can be freed from this position by gentle traction and gauze dissection of the chain from above

Once the rami communicantes which run obliquely upwards are cut, the chain is followed down to the second ganglion Its rami run in a transverse direction When these are clipped and cut the third
 the trunk is
 n removed
 vertebrae
 extent of

nerve and chain are removed including at least D_6 (Fig 365, B) Thereafter the lung is completely inflated and the lumbar portion of the operation is carried out

The diaphragm is opened widely This is preferably done by an incision paralleling the twelfth rib and 1.5 cm anterior to it One or two arteries near the crus will require ligation the remainder of the incision is essentially avascular With blunt dissection the tissue plane on the anterior surface of the psoas and quadratus muscles is de-

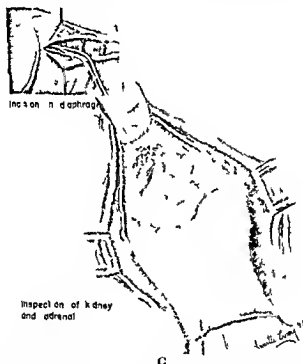


Fig 365 (Continued) -C The diaphragm is opened just anterior to the 12th rib and the kidney and adrenal inspected This view is obtained from the same position as in A

veloped The kidney and adrenal then are readily available for palpation and inspection (Fig 365 C) Thereafter they are retracted anteromedially and the chain followed through the diaphragm The twelfth dorsal ganglion is identified as a rule in the substance of the

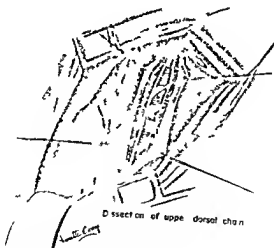
that covers the crus of the
2) Dissection is continued



Incision bed of 9th rib

Exposure of sympathetic chain
and greater splanchnic nerve

A



Dissection of upper dorsal chain

B

Fig 365—Transthoracic thoracolumbar sympathectomy A A generous incision has been made and the chest opened. The sympathetic chain and greater splanchnic nerve are exposed after opening the posterior pleura. This view is taken from directly above the incision.

B, The surgeon now dissects the dorsal chain as high as desired. This view is taken from the foot of the table showing the chain extending cephalad.

The disadvantages are (1) Exposure of the lower lumbar chain is more difficult than through the posterior incision (2) The presence of an old pleuritis may make it necessary to abandon the transpleural approach and perform an extrapleural dissection although to date this has not been necessary in any of our cases (3) The operating time is longer than with less radical methods (4) It has been observed that pulmonary complications and early postoperative pain are more common after the transthoracic than after the dorsal procedures

SUMMARY

1 The technics for extensive thoracolumbar sympathectomy are described briefly one intrapleural and the other extrapleural

2 These procedures are being applied to certain types of hypertensive patients in an effort to evaluate the usefulness of a more radical procedure

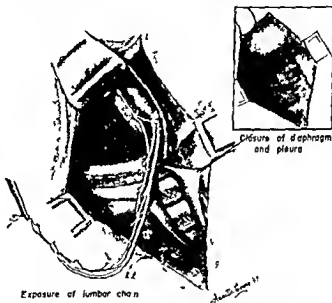
3 A decision as to the ultimate place of such procedures in the therapy of hypertension must await the further passage of time and prolonged clinical studies of the patients so treated

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below the second lumbar ganglion and the chain is excised. Occasionally the third lumbar ganglion has been obtained by this approach, but its exposure is difficult. For this portion of the operation, long retractors and a Cameron light are essential.

The great splanchnic nerve is then cut 1 cm proximal to the celiac ganglion. A silk cylinder or piece of tantalum is tied over the cut end of the nerve in an attempt to prevent regeneration into it. The diaphragm and posterior pleura are then sutured, the lung expanded and the chest wall closed.



D

Fig. 365 (Continued) —D The lumbar chain is now exposed. Thereafter the sympathetic chain and splanchnic nerves are excised and the diaphragm and pleura closed. This view is taken from the head of the table.

The advantages of the transpleural operation over the dorsal approach are as follows: (1) A more extensive removal of the thoracic chain is possible. (2) An anatomic dissection of the whole great splanchnic, the lower dorsal chain and their connections is obtained. The exposure of the thoracic portion of the chain is far superior to that afforded by the posterior approach. Contrasted with the extra-pleural incision of Hinton and Lord, this method allows frequent and complete expansion of the lung. This should diminish the incidence of postoperative pulmonary complications.

how they swing is the important thing. When the blood pressure swings up and the systolic has reached an arbitrary level of 80 mm of mercury, the pulse rate swings down, and the skin is warm and of good color, then patients are ready for surgery. Thus they are ready for surgery long before blood volume or blood pressure are restored to normal. In any consideration of resuscitation it must be remembered that surgery is an inseparable part of resuscitation as, for example, when major internal bleeding is occurring or when wide fecal contamination of the peritoneum is present. In some cases there can be no effective resuscitation without surgery.

TABLE I
GRADING OF SHOCK*

Degree of Shock	Blood Pressure (Approx)	Pulse Quality	Skin			Thirst	Mental State
			Temperature	Color	Circulation (Response to 1 measure bleeding)		
None	Normal	Normal	Normal	Normal	Normal	Normal	Clear and distressed
Slight	To 20% decrease	Normal	Cool	Pale	Definite slowing	Normal	Clear and distressed
Moderate	Decreased 20-40%	Definite decrease in volume	Cool	Pale	Definite slowing	Definite	Clear and some apathy unless stimulated
Severe	Decreased 40% to non recordable	Weak to imperceptible	Cold	Ashen to cyanotic (mottled)	Very sluggish	Severe	Apathetic to comatose little stress except thirst

* From "The Physiological Effects of Wounds" Maltby, T. R. Simeone, F. A. Beecher, H. K. Sullivan, E. R. Burnett, C. H. Shapiro, S. L. and Smith, L. D. Edited by H. K. Beecher. To appear.

A further principle that we established* is that if surgery cannot be undertaken at once we need not achieve better signs than these during the waiting period. The patient will not suffer as long as the systolic pressure is 80 mm of mercury, and the skin warm and of good color. Neither will he lose as much hemoglobin by renewed bleeding as he will if plasma, say, is used to raise the blood pressure higher than necessary during this waiting period.

* Beecher, H. K. and Burnett, C. H. Field Experience in the Use of Blood and Blood Substitutes (Plasma Albumin) in Seriously Wounded Men. The Medical Bulletin, No. African Theater of Operations II, (July) 1944 pp 2-7.

TIMING AS A FACTOR IN THE TREATMENT OF SHOCK

HENRY K. BEECHER, M.D.*

For reasons not altogether clear, a seriously wounded man, or a man depleted by blood loss during surgery, can often be resuscitated *once* with easy success, resuscitated to the point where he will tolerate the further strain of surgery. If he be allowed to slip into shock again, a second resuscitation is oftentimes either inadequate or impossible. Every surgeon who has dealt with these problems knows the importance of operating when the patient has achieved the best state he can in the minimum time. I should like to be specific about this a little later.

Such thoughts as these bring us to a reconsideration of what is and what is not possible in resuscitation. If our aim is restoration of the patient in shock to normal before surgery is undertaken, our goal is impossible. We had better face the facts and decide what is impossible, what is possible and what is desirable in resuscitation from shock. Certainly, even fairly brief periods of low blood pressure produce organic damage that will in some cases require days, not hours, to overcome. This is impossible to grant in the allotted time before emergency surgery.

In the treatment of shock as a preliminary to surgery we can restore blood volume and blood pressure to normal. This is possible. But is it necessary? We do not need to guess here, for we have a certain answer. It came out of work during the war. It is "No." "No," at least for organically sound individuals. We do not need to restore the blood volume and blood pressure to normal as a preliminary to safe emer-

of surgery?

In Table I the signs are presented that are useful (1) for characterizing the patient at a given time and (2) for estimating his probable course. It is necessary to bear in mind the probable course of events, as shown in Table I, for shock is not a static state, it is dynamic. Patients in shock do not stay the same—they get better or get worse.

The signs we need to guide us are trends rather than absolutes. Most important are blood pressure and the circulation in the skin.

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ENDOSCOPY

EDWARD B. BENEDICT, M.D., F.A.C.S.*

BRONCHOSCOPY

IN the early days bronchoscopic examination was undertaken chiefly for the removal of foreign bodies from the tracheobronchial tree. This was done chiefly by laryngologists who as a result of their knowledge of the throat became interested in the trachea and bronchi. With the development of thoracic surgery however diagnostic bronchoscopy has taken on a very great importance. Before performing an exploratory thoracotomy the thoracic surgeon would like to know either from his own observation or from the observation of one closely associated with him as much as possible regarding the appearance of the major bronchi. Adequate bronchoscopic experience can be obtained only after years of observation in all types of cases. The casual observer who may only do a few bronchoscopies each year can hardly be expected to give a complete report. As long as the bronchoscopist is doing frequent bronchoscopies and seeing a large amount of pulmonary pathology it does not make any difference whether he is primarily a laryngologist, thoracic surgeon, pulmonary internist or endoscopist.

Indications and Contraindications—The most frequent indications for bronchoscopy are hemoptysis, wheeze, bronchial obstruction or repeated attacks of so called pneumonia. These may be due to inflammatory processes, tumor or foreign body. There are very few contraindications to bronchoscopy and these must be weighed against the urgency of the procedure. Severe heart disease, aortic aneurysm

be considered individually.

Bronchiectasis—The case of patient who has had a

the question of bronchiectasis, benign or malignant bronchial tumor

* Endoscopist, Massachusetts General Hospital, Instructor in Surgery, Harvard Medical School, Boston.

The statement was made above that an attempt would be made to demonstrate the adequacy of these views. In studies (Beecher and Burnett *loc cit*) of the worst wounded drawn from 2553 battle casualties who reached a hospital alive (chiefly on the Anzio Beach head) (1) None of the 2553 died during surgery. (2) The over all death rate (April and May at Anzio including the great push) in 1623 men was 1.48 per cent. (3) The experienced surgeons dealing with these men were emphatic in their statements that the patients were well prepared for surgery.

TABLE 2

	When Prepared Accord- ing to Principles Stated in This Study*	Theater Practice as a Whole
Time from hospital entry to surgery	2 hrs. 21 min.	Average 6 hrs
Plasma	1 unit in hospital	3 units in toto
Blood	1,236 cc	*610 cc.

* Beecher H K and Burnett, C H *loc cit*

As shown in Table 2 the use of proper timing of resuscitation and surgery cuts the resuscitation time in half and the number of transfusions of whole blood from five to three. We shall probably never escape from the necessity of economy in the use of blood in civilian hospitals as well as in military situations. Two great military medical problems of the future concern (1) The resuscitation of great masses of the population exposed to atomic radiation with profuse bleeding from all surfaces. Certainly economy of blood will be necessary here. (2) The resuscitation of men wounded during military operations under conditions of great cold in Arctic and Antarctic regions where problems of blood supply must always be difficult. The necessity for economy of material both in peace and in war is evident. This statement needs no special pleading. The key to the absolutely necessary economy of blood is the correct timing of its use in resuscitation.

ENDOSCOPY

EDWARD B. BENEDICT, M D , F A C S *

BRONCHOSCOPY

IN the early days bronchoscopic examination was undertaken chiefly for the removal of foreign bodies from the tracheobronchial tree. This was done chiefly by laryngologists who as a result of their knowledge of the throat became interested in the trachea and bronchi. With the development of thoracic surgery, however, diagnostic bronchoscopy has taken on a very great importance. Before performing an exploratory thoracotomy, the thoracic surgeon would like to know either from his own observation, or from the observation of one closely associated with him, as much as possible regarding the appearance of the major bronchi. Adequate bronchoscopic experience can be obtained only after years of observation in all types of cases. The casual observer who may only do a few bronchoscopies each year can hardly be expected to give a complete report. As long as the bronchoscopist is doing frequent bronchoscopies and seeing a large amount of pulmonary pathology, it does not make any difference whether he is primarily a laryngologist, thoracic surgeon, pulmonary internist, or endoscopist.

Indications and Contraindications.—The most frequent indications for bronchoscopy are hemoptysis, wheeze, bronchial obstruction, or repeated attacks of so called pneumonia. These may be due to inflammatory processes, tumor, or foreign body. There are very few contraindications to bronchoscopy, and these must be weighed against the urgency of the procedure. Severe heart disease, aortic aneurysm, malignancy of the spine, extreme debility, or intercurrent acute disease would usually contraindicate bronchoscopy except for the removal of a foreign body which is causing severe symptoms. Each patient must be considered individually.

Bronchitis.—The usual patient with acute or chronic bronchitis will probably not require bronchoscopy. If, however, the symptoms persist

the question of bronchiectasis, benign or malignant bronchial tumor,

* Endoscopist Massachusetts General Hospital, Instructor in Surgery Harvard Medical School, Boston

foreign body and possibly lung abscess. If nothing more is found than a bronchitis the mucosa may show some areas of reddening and edema with easily bleeding mucosa. Such hemorrhagic areas may be cauterized with silver nitrate.

Bronchiectasis—The diagnosis of bronchiectasis depends chiefly upon the history of cough and expectoration together with the x ray findings of dilated bronchi on bronchography. Many patients give a history of hemoptysis and in such cases at least one diagnostic bronchoscopy is desirable in order to exclude the possibility of bronchial obstruction due to adenoma carcinoma stricture or foreign body. Sometimes the relief of an inflammatory process by dilating a stricture removing secretions thus opening up an airway results in definite clinical improvement. Patients who have bilateral bronchiectasis involving so many lobes of both lungs that surgical attack is impossible are benefited by repeated therapeutic bronchoscopies performed at intervals of one to three or four weeks depending on the severity of the condition. At such treatments the secretions are thoroughly aspirated from both major bronchi and 5 cc. of 10 per cent gomenol is introduced. Such patients over a period of months or years have less sputum less foul odor an improved appetite and gain weight and strength.

Bronchography—The bronchoscopist may be called upon to perform bronchography. This used to be done by injecting iodized oil through the bronchoscope but it has been found in recent years that better results are obtained by introducing the oil through a catheter. This catheter may be placed between the vocal cords by the bronchoscopist immediately after bronchoscopic examination. In cases of bronchiectasis where large amounts of secretions are present such secretions are best aspirated bronchoscopically before the bronchogram and a better filling is thus obtained. The catheter method described by Adams and Davenport¹ using small amounts of iodized oil

tremely important

importance to localize the abscess. This should always be done in addition to fluoroscopy and postero anterior exposure. Bronchoscopy may then be indicated to rule out a carcinoma which may be present in addition to the septic process or to still further localize the exact bronchial orifice from which the pus is exuding. Sometimes it will be found bronchoscopically that the abscess is due to bronchial obstruc

tion caused either by adenoma, carcinoma, foreign body or some type of stricture. These may be partially or wholly relieved by the bronchoscopist or if not completely relieved the proper surgical approach will be indicated. In the past when surgical drainage of lung abscess often yielded such unsatisfactory results repeated bronchoscopic aspiration of secretions were performed with the idea of draining the abscess through the bronchoscope. These results usually left a great deal to be desired because the abscess cavity is usually located well beyond the reach of the bronchoscope or the bronchoscopic aspirator. The straight or curved aspirators can, however, be introduced into various branches, secretions aspirated and sometimes inflammation or other obstructions relieved with definite clinical improvement. The usual medical measures should also be employed, including rest in bed, postural drainage, adequate diet, transfusion if necessary, intramuscular penicillin, and sometimes aerosol penicillin. Since some lung abscesses of rather short duration are cured by medical means alone, it is difficult to evaluate the additional benefit obtained by bronchoscopy. Each case must be considered individually by a thoracic group including pulmonary internist, thoracic surgeon, radiologist, and endoscopist.

Tuberculosis—Bronchoscopy is now used very frequently in pulmonary tuberculosis. Contrary to earlier opinions, it has been found that bronchoscopic examination in tuberculosis has not spread the disease but does give valuable information regarding the presence or absence of tracheobronchial tuberculosis. There are three forms of tracheobronchial tuberculosis, the proliferative, ulcerative and stenotic. In the proliferative form there is the formation of conglomerate tubercles with submucosal proliferation. In the ulcerative type, there is a diffuse or circumscribed loss of mucosa. Either type may go on to the stenotic type in which there is definite scar tissue formation leading to partial or complete bronchial obstruction. The indications for bronchoscopy in tuberculosis are as follows:

- I Obstructive signs and symptoms as shown by
 - a Atelectasis
 - b Wheeze
 - c Difficulty in raising sputum
 - d Persistent cough or dyspnea
 - e Intermittent febrile attacks
- II Positive sputum when parenchymal disease is controlled or absent.
- III Hemorrhage unexplained by parenchymal disease
- IV Contemplated collapse therapy to determine the possible presence of tuberculosis in the trachea or contralateral bronchus

Some cases of intermittent bronchial obstruction following thoracoplasty may be greatly relieved by bougienage and bronchoscopic aspiration of secretions. Occasionally it may be found that a patient

with a positive sputum suspected of having bronchial tuberculosis may actually have a carcinoma of the bronchus. This differentiation is only possible by bronchoscopy. The differential diagnosis of adenoma also comes up in tuberculosis with bronchial obstruction. The increasing use of lobectomy and pneumonectomy in certain cases of pulmonary tuberculosis has led to the surgeon to the presence of the presenc

1. *Prognosis.*—The prognosis is bad. Regardless of therapy many cases of bronchial tuberculosis go on to a rather rapidly fatal termination.

Asthma.—On the whole the value of bronchoscopy in asthma has been somewhat overrated. There is no doubt that the statement "all that wheezes is not asthma" is a very important one and bronchoscopy should no doubt be done more frequently to make sure that there is no bronchial obstruction from adenoma, carcinoma, stricture or foreign body. Not infrequently the only positive answer is obtainable by bronchoscopy. On the other hand a word of caution is advisable regarding the use of the bronchoscope in middle aged or elderly patients with only a short history of asthma as such patients may have a status asthmaticus with secretions plugging all of the secondary bronchi and bronchioles and may go into a sudden bronchospasm at the time of bronchoscopy with rapidly fatal termination.

There are some patients who are known asthmatics who may be benefited by repeated bronchoscopic aspiration of excessive amounts of thick tenacious secretions. Such patients are the ones who have an associated severe bronchitis and perhaps a real bronchiectasis in addition to their asthma.

Tumor.—Almost any type of benign or malignant tumor may occur in the bronchus.

Carcinomas of one type or another.—squamous cell, adenocarcinoma, undifferentiated varieties. One recent case in this hospital was a basal cell carcinoma which is extremely rare. Metastatic carcinomas and sarcomas³ have been seen in the bronchus but although common in the lung parenchyma they are unusual in the major bronchi. When they do occur the diagnosis may be established by bronchoscopic biopsy and partial temporary relief of bronchial obstruction may result from bronchoscopic removal.

Bronchial Adenoma.—These tumors usually occur in young individuals and they are generally regarded as benign a few of them

have been reported to metastasize to one regional mediastinal gland. Distant metastases probably do not occur. The importance of bronchial adenoma is the occurrence of bronchial obstruction with subsequent infection and possibly drowned lung. The history is usually a long one of cough with repeated hemoptyses, wheeze, and sometimes repeated attacks of so called pneumonia. Bronchoscopic examination is usually essential for exact localization of the tumor and for biopsy. The treatment of adenoma may be either bronchoscopic or surgical. The modern tendency is more and more towards lobectomy or even pneumonectomy depending on the location of the tumor. The justification for major surgery in the treatment of so small a tumor as a



Fig 366

Fig 367

Fig 367 (V N M G H No 207971)—Typical cauliflower appearance of bronchogenic carcinoma obstructing right lower lobe bronchus just below the middle lobe orifice. Bronchoscopically this tumor was considered operable because of its location without fixation and without widening or fixation of the carina.

benign adenoma is based on the fact that (1) often a large part of the tumor is extrabronchial, (2) the intrabronchial portion may be causing complete obstruction and may have already caused irreparable damage to the lung, (3) bronchoscopic removal may be hazardous because of the possibility of hemorrhage and may be incomplete because of inability to remove all of the base and the extraluminal portion of the tumor—recurrences are therefore not uncommon, (4) rare local metastases have been reported. Here again each patient must be considered individually, and the rare elderly patient with a small adenoma not causing very much in the way of symptoms may be clinically almost entirely relieved by bronchoscopic removal. In

fact one or two bronchoscopic removals of the tumor may be adequate to give almost complete relief. On the other hand, these tumors tend to recur and bronchoscopy should be repeated occasionally to examine the site of the tumor and to remove any recurrence.

Bronchogenic Carcinoma.—Unfortunately bronchogenic carcinoma is a more common disease than we used to think. Better methods of diagnosis by x ray and by bronchoscopy have resulted in more frequent positive diagnosis. Lobectomy and pneumonectomy have provided a surgical attack with at least a possibility of cure. The end results of thoracic surgery for carcinoma of the lung are, however, very disappointing. Very few patients are finally cured but some get a considerable palliative benefit. All lung tumors are of bronchogenic origin and about 70 per cent of them arise in the major bronchus within reach of the bronchoscope. The bronchoscopist can therefore, tell in such cases the exact location of the tumor and can obtain a biopsy to determine its exact histology. A considerable amount of information can be obtained by bronchoscopy as to the operability of a bronchogenic carcinoma (Fig. 367). If the tumor is located in the trachea or invading the carina the location is such that it cannot be removed. Widening and fixation of the carina is almost certain proof of invasion of the mediastinum by neoplasm and is thus secondary evidence of inoperability. Fixation of the bronchus in the region of the tumor is also a bad prognostic sign as to surgical excision. The use of the right angle telescope which permits a view at right angles into the upper lobe bronchus has widened the range of bronchoscopic visibility. Unfortunately, biopsy around the corner is usually not possible, but the appearance of a nodular stenosis just inside one of the upper lobe orifices is of considerable significance.

With increasing knowledge regarding the incurability of highly malignant carcinomas a biopsy report of oat cell carcinoma or highly undifferentiated carcinoma may save an unnecessary exploratory thoracotomy. On the other hand, it must be remembered that a considerable number of tumors are beyond the reach of the bronchoscope and that, therefore, a negative bronchoscopy by no means excludes carcinoma, in fact, some peripheral carcinomas beyond the reach of the bronchoscope seem to be the most favorable for resection and possible cure. Exploratory thoracotomy should, therefore, be readily undertaken under such circumstances particularly when a small suspicion shadow persists by x ray examination. Although lobectomy or pneumonectomy offers the only hope of cure of carcinoma of the lung x ray therapy, particularly in the highly malignant types of neoplasm may give very excellent though rather temporary palliative results. A few cases can be cited where the x ray shadow completely disappeared after x ray therapy and where the intrabronchial portion of the tumor was no longer visible at postradiation bronchoscopy. Other

forms of treatment for carcinoma of the lung include nitrogen mustard and castration. Further experience will be necessary before any proper evaluation of these forms of treatment can be given.

Foreign Body.—Foreign body removal is an extremely important part of the work of any bronchoscopist, but in many large bronchoscopic clinics it forms only a comparatively small percentage of the total volume of work. The diagnosis of foreign body in the tracheo-bronchial tree depends first on a carefully taken history. Unfortunately the possibility of foreign body may be overlooked when taking the history and even if the patient is questioned on the matter of choking he may have forgotten the episode. Children and even adults may aspirate foreign bodies without knowing it. Not infrequently a patient will give a history of a choking spell while eating and yet will abso-



Fig 368 (E T M G II No 198577)—Foreign bodies consisting of nutshell fragments in right lower lobe bronchus of a 54 year old male with no foreign body history. The clinical diagnosis had been lung abscess of ten months duration and the x ray diagnosis bronchiectasis. Irreparable lung damage had taken place from long sojourn of the septic foreign body.

lutely deny the possibility of having aspirated a foreign body. All too frequently in spite of a suggestive history the physician may believe that no foreign body has been aspirated and may, therefore, take no x ray or delay x ray examination until several weeks have elapsed. Such patients may be thought to have a pneumonia which will eventually clear up. Physical examination should always be done but may not be diagnostic. X ray study is absolutely indispensable, including fluoroscopy, postero anterior film and lateral film.

Bronchoscopy must be performed in every case in which foreign body is suspected. Most M. I.

handled when the regular bronchoscopic team is available and the optimum time of removal has been reached. Metallic foreign bodies may remain in the bronchial tree for many years if they are not causing bronchial obstruction. A patient may even be completely unaware of the presence of such a foreign body (Fig. 368). Foreign bodies of long sojourn in the tracheobronchial tree causing bronchial obstruction and pulmonary suppuration may produce irreparable lung damage necessitating a later lobectomy. The immediate relief of bronchial obstruction by bronchoscopic removal of the foreign body may be very dramatic but follow up studies several months later may reveal a persistent atelectasis or bronchiectasis, which if producing much in the way of symptoms will be an indication for lobectomy or even pneumonectomy.

Most foreign bodies can be removed by the experienced bronchoscopist under local anesthesia. In difficult cases, however, a general anesthetic may be necessary and fluoroscopic guidance may be required.

Postoperative Atelectasis—Postoperative atelectasis is a rather common complication of surgery. The onset is usually sudden, occurring one to three days following operation. The symptoms are pain in the chest, elevation of temperature and pulse with dyspnea, distress and possible cyanosis. Although the condition frequently clears spontaneously by cough or change in the position of the patient, if this fails bronchoscopic aspiration of the mucus plug causing the obstruction is indicated and will often be followed by dramatic improvement. Bronchoscopic aspiration for postoperative atelectasis is now considered so important that many clinics are training their anesthesiologists to carry out this procedure. In this way more serious complications such as pneumonitis, pneumonia, atelectasis, bronchiectasis and lung abscess may be prevented.

ESOPHAGOSCOPY

Indications—The commonest symptom of esophageal disease is dysphagia. All patients complaining of dysphagia should be carefully examined by a competent radiologist followed in many cases by esophagoscopy. X-ray examination is of fundamental importance and will usually determine whether or not esophagoscopy is indicated.

... some degree of esophagitis which has not been disclosed by x-ray. If esophageal symptoms persist in the presence of a negative x-ray, esophagoscopy should be performed anyway. Persistent substernal pain unexplained by other examinations may be an indication for esophagoscopy. Hematemesis

unexplained by other studies may also be an indication for esophagoscopic examination. Regurgitation with or without vomiting is a common symptom of esophageal disease and may be an indication for esophagoscopy.

Contraindications.—There are almost no absolute contraindications to esophagoscopy in experienced hands. Acute illness may require postponement except in the case of a foreign body. Extreme debility may likewise be a relative contraindication. One might hesitate to do an esophagoscopy in the presence of a large aneurysm of the thoracic aorta.

Carcinoma—Carcinoma is the most frequent and most important tumor of the esophagus. The commonest symptom is increasing inability to swallow solid foods. Many patients and some physicians completely disregard this important symptom and consider the matter hysterical. This is a very serious error because dysphagia calls for immediate x ray examination followed in many cases by esophagoscopy. If an irregular obstructing mass is found by x ray examination the chances are that we are dealing with malignancy. Esophagoscopy is needed, however, in order to get a biopsy and establish the exact histologic diagnosis. Major surgery for carcinoma of the esophagus has now reached to all patients a contraindication.

Successful esophageal resections have been performed for very high carcinomas. In fact, Sweet⁴ has made an anastomosis between the stomach and the esophagus above the level of the arch of the aorta. The Wookey⁵ procedure enables resection of carcinomas of higher location. The most important consideration is early diagnosis.

Carcinoma of the esophagus usually appears to the endoscopist as an irregular nodular, sometimes cauliflower, mass partially or completely obstructing the lumen of the esophagus, sometimes with complete fixation of the esophagus. In lesions at about the level of the crossing of the left main bronchus, bronchoscopy is indicated in addition to esophagoscopy in order to determine whether the growth has caused fixation of the left main bronchus or may have actually invaded it. Contraindications to esophagectomy include extreme old age or debility, or known metastatic disease, in regional glands or in the liver. (See Peritonoscopy.) In such inoperable cases or in cases which have been explored and found inoperable the endoscopist may be called upon to dilate the esophagus by bougienage. This may be done at the time of esophagoscopy or may be accomplished by having the patient swallow a thread⁶ using the thread as a guide to subsequent bougienage. Such bougienage may be easily and safely performed in the office or in the outpatient department. By a combination of bougienage and x ray therapy, such patients can usually be

enabled to swallow liquids strained vegetables, and ground meat, thereby avoiding gastrostomy.

Carcinoma of the upper part of the body of the stomach not infrequently invades the lower end of the esophagus. The extent of the invasion of the esophagus may be fairly accurately determined by x-ray examination. Esophagoscopy may aid also in determining the extent of the invasion and a biopsy may reveal the exact nature of the lesion. Sometimes submucosal invasion of the esophagus is not grossly visible to the esophagoscopist but a biopsy of this area may result in a positive histologic diagnosis of submucosal invasion. Transthoracic approach to such tumors of the stomach will be definitely indicated.

Benign Tumor.—Benign tumors of the esophagus are uncommon. They may produce the same symptoms of esophageal obstruction as are produced by malignant tumors. On the other hand they grow slowly and may produce very little obstruction. They may be pedunculated or submucosal. Occasionally the pedicle of the benign tumor may be so long that if it is located in the upper end of the esophagus the tumor itself may be regurgitated or vomited into the mouth. Among the benign tumors of the esophagus should be mentioned fibroma, lipoma, adenoma, papilloma and myoma. Although a few benign tumors of the esophagus have been successfully treated by esophagoscopy removal with improved technique of esophageal resection it seems advisable that most of them be treated surgically.

Esophagitis.—Probably the commonest disease of the esophagus is esophagitis. This is recognized only by esophagoscopy. It not only occurs as an independent entity but also occurs in association with carcinoma, ulcer and benign stricture of the esophagus. It is manifested by reddening and edema of the esophageal mucosa frequently with some adherent secretion and sometimes accompanied by small erosions with or without hemorrhagic areas. Esophagitis is usually caused by excessive use of alcohol but sometimes may be caused by dietary indiscretions such as the use of very hot or highly seasoned foods. Treatment includes the use of bland diet with frequent feedings, complete elimination of alcohol and tobacco and adequate dental attention.

Benign Stricture.—A not infrequent complication of esophagitis is benign stricture of the esophagus. This also occurs commonly in association with peptic ulcer of the esophagus, duodenal ulcer and hiatus hernia. In a previous communication Benedict⁷ reported forty-four patients with benign stricture of the esophagus. Almost all of them were over fifty years old making it extremely important to rule out carcinoma by esophagoscopy and biopsy. In forty-four cases the benign stricture was associated with hiatus hernia in seventeen, with duodenal ulcer in fifteen and with esophageal ulcer in eight. Esophagitis was almost always present. When it has been proved beyond

any reasonable doubt that carcinoma is not present treatment is by esophagoscopy and bougienage or by the use of graduated olive bougies passed over a previously swallowed thread as a guide. It can not be emphasized too often that blind bougienage is dangerous. There is however, very little risk to gentle dilatation by means of bougies passed through the esophagoscope under direct vision or when a thread is used as a guide. The importance of the thread is to keep the bougie within the lumen of the esophagus and for this purpose it must be securely anchored by having it pass through a large part of the small intestine and then pulling it very tightly up through the mouth so that it will actually act as a trolley. A few benign strictures of the esophagus are intractable to bougienage and in such cases major surgery may be justifiable.

Esophageal Ulcer.—Peptic ulcer of the esophagus is rather rare. The diagnosis may be made by x ray examination and confirmed by esophagoscopy. Quite often a small ulcer visible by x ray is completely hidden to the endoscopist by red dening bleeding and edema. On the other hand small erosions and areas of hemorrhage may be visible to the esophagoscopist which are not visible to the radiologist. Esophageal ulcers may heal spontaneously by the use of a bland diet frequent feedings elimination of alcohol and tobacco and careful dental attention. Some benign esophageal ulcers however go on to stricture formation in which case bougienage must be carried out. Occasionally major surgery will be indicated.

Hiatal Hernia.—A hiatal hernia is a protrusion of the stomach through the diaphragm at the esophageal opening. It is usually asymptomatic but may cause reflux esophagitis, chest pain, and dysphagia. Diagnosis is often made by x-ray examination or endoscopy. Treatment is usually conservative, involving diet and medication, but surgery may be required in severe cases.

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Lye Burns.—Lye burns of the esophagus are caused by the ingestion of caustic substances. They are often fatal. The diagnosis is usually made by the history and the appearance of the esophagus during endoscopy. Treatment is supportive and may include surgery in severe cases.

Lye Stricture.—Stricture caused by the ingestion of caustics are often produced by persons attempting to commit suicide but may also occur accidentally. Serious burns occur in the mouth, esophagus and sometimes in the stomach. The lumen of the esophagus may be very markedly narrowed or in fact completely obliterated. Gentle dilatation should be carried out thoroughly. The lumen should never be lost and need never be lost if the patient is required to swallow a thread early in the disease. This will not only serve to keep the lumen open but will provide a guide for subsequent bougienage.

Cardioesophageal Junction.—The junction of the esophagus and stomach is a common site for various conditions. The most common is reflux esophagitis, which is caused by the backflow of stomach contents into the esophagus. Other conditions include hiatal hernia, esophageal ulcers, and strictures. Diagnosis is usually made by endoscopy or x-ray examination. Treatment is usually conservative, involving diet and medication, but surgery may be required in severe cases.

advisable to have the patient purchase a bougie and learn to pass it daily at

home. There are patients with very long-standing cardiospasm and a tremendously dilated tortuous esophagus in whom it is not possible to pass the bougie through the cardiac orifice. Such patients should be hospitalized and esophageal lavage carried out repeatedly, using warm sodium bicarbonate solution, following which esophagoscopy may be performed and bougies passed under direct vision.

Esophageal Varices.—Esophageal varices (Fig. 369) are a frequent cause of

than any other form of treatment, the injection of sclerosing solutions into esophageal varices may be well justified.



Fig. 369 (J. M. M. G. II No. 30)—Esophageal varices as seen through the esophagoscope.

Scleroderma.—A good many patients with scleroderma have no complaints referable to swallowing. On the other hand, with careful questioning such patients may admit some dysphagia. The cutaneous lesions may cause so much pain and

below the level of the cricopharyngeus muscle and consists of fibrous strands crossing the esophageal lumen. A web may be observed by x-ray examination and may also be seen at the time of esophagoscopy. It is easily traversed by the esophagoscope following which there is a dramatic relief of the previous dysphagia.

Functional Dysphagia.—Emotionally unstable patients of either sex may complain of difficulty in swallowing. Fear of choking may be a prominent symptom. There may be equal difficulty in swallowing liquid and solid foods. No patient should be accused of having functional dysphagia until all organic causes of difficulty in swallowing have been excluded by radiology and esophagoscopy.

x ray Most of them do not require esophagoscopy either for diagnosis or treatment The average size esophageal diverticulum does not produce symptoms and does not require treatment On the other hand most large hypopharyngeal diverticula do require surgical intervention because of regurgitation or pressure on the esophagus causing some obstruction Such treatment can be readily carried out surgically without the use of the esophagoscope

Extrinsic Pressure—Occasionally mediastinal tumors or glands will produce extrinsic pressure on the esophagus which may cause confusion by x ray examination In such cases esophagoscopy will be indicated to rule out intrinsic disease of the esophagus

GASTROSCOPY

Gastroscopy is an important adjunct to x ray examination It is in no sense a competitive method but an additional one Lesions may be seen by one method which are invisible to the other method X ray examination is always carried out first because it is a simpler procedure and may give an adequate diagnosis without gastroscopy Moreover it is important for the gastroscopist to know by x ray examination that the esophagus is normal before blindly passing the gastroscope

Indications—Gastroscopy is indicated in all patients suspected of having gastritis Such cases include those of unexplained gastrointestinal hemorrhage so called gastric neurosis unexplained persistent

ulcer and to follow the healing process in benign ulcer In straight forward cases of duodenal ulcer gastroscopy is seldom indicated It may however be indicated in certain cases to study the gastric mucosa for the presence of gastritis gastric erosions or gastric ulcerations In carcinoma gastroscopy will be indicated to establish or confirm a doubtful x ray diagnosis and to determine the gross appearance the extent and operability of the lesion Gastroscopy may also be of use in helping to determine a diagnosis of sarcoma or lymphoma benign tumor polyposis pseudopolyposis and occasionally foreign body

Contraindications—There are very few absolute contraindications to gastroscopy Obstructing lesions of the esophagus such as benign stricture and carcinoma will make it mechanically impossible to pass the gastroscope It is inadvisable to pass the gastroscope in certain cases of esophageal diverticula Acute infectious disease may make it

advisable to postpone gastroscopy. Extreme debility may be a contra indication.

Complications—Trauma to the esophagus with minor or major perforation is a possibility but is rare in good hands and with the proper selection of cases. Although such perforation is not to be considered lightly, the advent of chemotherapy has rendered the prognosis much less uniformly fatal.

Instruments—The original Wolf Schindler flexible gastroscope is still an excellent instrument. It is the most flexible of all the modern gastroscopes and is therefore the easiest to pass. Two American companies have made minor improvements enabling the operator to change the angle of the mirror at the distal end by mechanical or electromagnetic control at the proximal end. The greatest improvement of all however has been made by an English company in the Herman Taylor flexible gastroscope which has a ratchet on the proximal end enabling manipulation of the flexible tip. This permits study of many areas in the stomach previously inaccessible to the other ordinary types of gastroscopes. Work is in progress now toward obtaining a much needed channel for aspirating secretions and toward the incorporation of a biopsy forceps.

Technique—The simpler the technic the better will be the result. It is important to have the patient quiet and relaxed before the introduction of the gastroscope. For this reason gastric lavage or gastric aspiration should be avoided if possible. In cases of pyloric obstruction with gastric retention gastric lavage may be carried out several hours before the procedure and before the preliminary sedation is given. Four per cent cocaine gargle gives adequate throat anesthesia and avoids any unnecessary throat intubation. Having the patient's head rest on small pillows gives the patient a sense of security which he does not have when the head is held in the hands of an untrained assistant.

The Normal Stomach—Normally the gastric mucosa is orange red in color, the surface is smooth, rugae are comparatively small and flatten out well with air inflation. Peristaltic waves are seen passing from a round angulus over a smooth antrum part of the way or all of the way to a tight closure at the pylorus. In about one third of the cases the pylorus may not be visible due to angulation.

Gastritis—Three types of gastritis are generally recognized,¹⁰ the first superficial which corresponds to what the pathologist calls acute gastritis. The second type of gastritis is the hypertrophic which corresponds pathologically to the chronic gastritis, and thirdly, there is the atrophic gastritis or gastric atrophy which is also termed atrophy by the pathologist.

Superficial gastritis is characterized gastroscopically by reddening of the mucosa, edema, and often the presence of adherent secretion (Fig. 370). Such an acute or superficial gastritis may be caused by alcohol or by indiscretion in diet. It may also be seen in acute infectious disease. Increased nervous tension may possibly play a part. Excessive use of tobacco is a possible factor. X-ray examination is likely to be entirely negative. Treatment includes bland diet with frequent feedings, complete elimination of alcohol and tobacco, adequate rest

and freedom from worry. Mild forms of the disease respond readily, but in severe cases it may take six months or longer for clinical and gastroscopic improvement. Contrary to some opinions, gastroscopic improvement may correspond very accurately with clinical improvement.

Hypertrophic Gastritis—This disease is characterized gastroscopically by the appearance of warty elevations in the mucosa sometimes giving it a cobblestone appearance. Pathologically the deeper layers are involved and the process is chronic. The superficial and hypertrophic forms often occur together in the same stomach with or without erosions and superficial ulcerations. Some years ago Benedict and Mallory¹¹ studied resected gastric specimens and found a satisfactory correlation between the pathological and the gastroscopic finding in



Fig. 370 (A. B. M. G. H. No. 180232) —Acute superficial gastritis with reddening, edema and adherent secretion.

the various types of gastritis. The severe hypertrophic type of gastritis responds very much less satisfactorily to the usual type of treatment, namely, bland diet with frequent feedings, elimination of alcohol and tobacco and adequate dental attention.

Atrophic gastritis or gastric atrophy may be the end product of an infectious process or may be the result of a deficiency disease. Patches of gastric atrophy occur commonly in elderly people and are almost always found in untreated advanced pernicious anemia. The typical gastroscopic appearance is that of a very pale, smooth, thin mucosa with numerous blood vessels readily visible shining through. Rugae are small or absent. Very low or absent hydrochloric acid is the rule. Intensive liver therapy will usually result in clinical improvement and may result in gastroscopic improvement manifested by a return to

normal color more nearly normal rugae and absence of visible blood vessels. In about half the treated cases however there is no gastroscopic improvement.

Gastritis is commonly seen in the postoperative stomach. The commonest form is the superficial or acute variety. Hypertrophic or atrophic changes may also occur. Postoperative gastritis is probably not a separate entity. The usual form of treatment should be used.

Varying degrees of hemorrhage occur in gastritis without ulcer. Massive and even fatal hemorrhage has occurred from multiple gastric erosions or from a mucosa which is friable and from which blood oozes apparently from every square millimeter. Some degree of superficial or acute gastritis is always present when there is hemorrhage. In addition there may be hypertrophic or atrophic changes. Hemorrhage from gastritis is such an important entity that all patients with unexplained gastrointestinal hemorrhage should have gastroscopic examination.

The x ray diagnosis of gastritis is comparatively unsatisfactory. A negative x ray examination does not rule out gastritis. A positive x ray merely indicates the possibility of gastritis but does not definitely establish the diagnosis nor does it indicate the type of gastritis present or the presence or absence of erosions or superficial ulcerations. Occasionally the radiologist will report the presence of hypertrophic gastritis when the gastroscopist will find a normal or atrophic mucosa. In general careful attention should be paid to the x ray diagnosis of gastritis by a competent radiologist and gastroscopic examination should then be carried out to confirm it and to establish the type and severity of the disease.

In severe types of gastritis differential diagnosis from carcinoma may be very difficult. In such cases both the radiologist and the gastroscopist may be in doubt. Both methods of study should be used as one method may reveal abnormalities which are not visible by the other method. In some cases the only way to settle the matter is exploratory laparotomy and probably subtotal gastric resection. It is better to do a subtotal resection for hypertrophic gastritis than to allow a carcinoma of the stomach to grow to inoperability.

Gastric Ulcer.—Most true peptic ulcers of the stomach are diagnosed by x ray examination. There are however some which are not visible by x ray which are found by gastroscopy. These are usually the superficial ulcers. Conversely there are a number of peptic ulcers of the stomach which are visible by x ray but usually because of mechanical difficulties may not be visible by gastroscopy. Gastroscopy will be indicated to confirm the x ray examination to demonstrate possibly more than one ulcer and to help differentiate benign from malignant lesions. In some cases healing may be better studied by gastroscopy than by x ray.

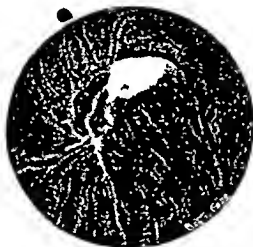
Benign Tumor.—Benign tumor of the stomach includes pseudopolyps, true polyps, adenomatous polyps, leiomyomas and neurofibromas. Such tumors may be single or multiple. Pseudopolyps are merely thick, edematous folds of mucosa which usually flatten out readily when the stomach is inflated with air and are easily differentiated by gastroscopy from true polyps. Pedunculated polyps or papillomas of epithelial origin are not uncommon. Adenomatous polyps attached by a broad sessile base are not uncommon in the stomach. They frequently occur in an atrophic mucosa and about 40 per cent of them become malignant. Multiple adenomatous polyps may occupy almost the entire mucosa of the stomach. All patients with pernicious anemia or gastric atrophy should have frequent x ray examination and gastroscopy in order to determine the presence or absence of adenomatous polypi or carcinomas. Adenomatous polyps are recognized gastroscopically by their broad base and their mucosal origin. Because of the possibility of malignancy, they should be resected. Neurofibromas or fibromyomas are recognized gastroscopically because of their submucosal origin. They are usually covered by normal appearing gastric mucosa. They, therefore, appear as smooth rounded submucosal tumors. Small surface erosions or ulcerations may be present and may cause bleeding. Such tumors should usually be resected because of the symptoms they produce or because of the possibility of malignancy.

Carcinoma.—Carcinoma is by far the commonest malignant tumor of the stomach. Early diagnosis and early operation afford the only hope of cure. In order to arrive at an early diagnosis, all methods of gastric study should be used, including careful history, physical examination, laboratory studies, x ray examination and gastroscopy. Patients with an atrophic gastric mucosa are particularly likely to develop carcinoma. Such patients should be examined by x ray and by gastroscopy at least three times a year. Unfortunately, a large gastric carcinoma may be present and still be giving practically no symptoms. When a large fairly obvious gastric tumor is present by x ray, gastroscopy may be unnecessary. In some such cases, however, gastroscopy may be helpful in determining the exact location and extent of the process, thus enabling the surgeon to decide on the transabdominal or transthoracic approach.

Occasionally the gastroscopist may demonstrate a tumor of the stomach which was difficult or impossible to demonstrate by x ray. More often he will be called upon to differentiate between benign and malignant gastric ulcers.

Gastroscopy will be comparatively easy. It may, however, be extremely difficult. In cases of gastritis peristalsis is usually normal, whereas in carcinoma the peristaltic wave is likely to be distorted. The response to air inflation

is another differential point. In gastritis there should be no rigidity whereas in carcinoma the introduction of air will suggest a rigid gastric wall. Warty elevations may be present in either gastritis or carcinoma but the elevations are likely to be more nodular in carcinoma. Erosions with or without hemorrhage may be present in either case as may also sup-
of the
usually
have irregular margins and a dirty or hemorrhagic base. Unfortu-



"

Fig 3-1 (J. H. M. G. H. No. 3817-3) Proven malignant ulcer lesser curvature with constant deformity of the angulus raised nodular margins and a sloughing base over which no peristaltic wave passed. X ray examination in this case suggested either a benign or a malignant ulcer.

nately, there is at the present time no satisfactory method of obtaining a biopsy from the stomach. The gross gastroscopic appearance of a carcinoma may however give some indication of the degree of

Sarcoma.—Sarcoma is a rare tumor of the stomach. When it occurs it is usually impossible to differentiate it from carcinoma by any diagnostic method.
Lymphoma.—Lymphoma of the stomach is also rare. Usually the gastric rugae

are unusually thick. Superficial erosions and ulcerations occur in different parts of the stomach, healing and then reappearing in other locations. Differential diagnosis by x ray or by gastroscopy is almost impossible. The radiologist will usually report a very severe gastritis and may mention the possibility of lymphoma or even an infiltrating type of carcinoma. The gastroscopist will note a very marked verrucous appearance with superficial erosions and ulcerations and a failure of the gastric wall to distend normally to air inflation. He will also note extremely thick folds which do not flatten out in quite the normal manner. Severe gastritis will be obvious and the likelihood of lymphoma may be suspected. In a recent case the radiologist felt sure of serious gross disease in the stomach; the gastroscopist put as his first diagnosis lymphoma with severe gastritis, and the pathologist after the specimen was resected was able only to find gastritis in the gross specimen but found definite lymphoma with gastritis histologically. Lymphoma, however, has been suspected by x ray or gastroscopy on some occasions when it was not proved surgically or histologically. When lymphoma is seriously suspected a subtotal gastric resection must be performed in order to make a final histologic diagnosis. Localized lymphoma may be adequately resected surgically but in many cases other areas of lymphoma will be present and only palliative x ray therapy can be given.

Correlation of Gastroscopic, Roentgenologic, and Pathologic Findings in Diseases of the Stomach.—In 245 cases of proved carcinoma,¹² gastric ulcer, duodenal ulcer, jejunal ulcer, gastritis, benign tumor, lymphoma, sarcoma, metastatic carcinoma of the stomach wall, and normal stomach, an attempt was made to correlate the roentgen and gastroscopic findings in each case with the known pathologic diagnosis. Although the

with gastroscopy
way competitive,

gen examination appears to be superior to gastroscopy and in other cases gastroscopy appears to be superior to the roentgen ray. The roentgen examination and gastroscopy were about equal in 54 per cent of the cases. Roentgen examination was considered superior in 29 per cent, gastroscopy superior in 17 per cent. The chief causes of failure in gastroscopy were mechanical. If the gastroscopist can get a satisfactory view of the lesion, a correct diagnosis can be made. If a correct diagnosis are given by gastroscopy, the gastroscopist must be improved and biopsies easily taken. Greater diagnostic accuracy is obtainable when both methods are used cooperatively than when either method is used alone.

PERITONEOSCOPY

The peritoneoscope is an endoscopic instrument used for examining the peritoneum of the abdominal cavity and pelvis. With this instrument it is possible to satisfactorily examine the surface of the liver, the visible portion of the abdominal and pelvic peritoneum, the uterus, and frequently both tubes and both ovaries. The instrument is of little or no value in inspecting deeper organs.

Indications.—Peritoneoscopy is indicated in order to save an exploratory laparotomy (1) by demonstrating hopelessly advanced carcinoma of the liver or peritoneum, or (2) by positively establishing a diagnosis that would otherwise require exploratory laparotomy. It is, therefore, indicated in many cases of liver disease including some cases of cirrhosis, hepatitis, primary carcinoma and metastatic carcinoma. Ascites not of cardiac or renal origin may be due to cirrhosis of the liver, tuberculous peritonitis or carcinomatosis. The differential diagnosis may be made readily by peritoneoscopy and biopsy. Multiple abdominal or pelvic masses may mean carcinomatosis and may be an indication for peritoneoscopy.

Contraindications.—Contraindications include severe disease of the cardiorespiratory system where pneumoperitoneum might embarrass the heart or the lungs. The presence of multiple adhesions is a relative contraindication. The peritoneoscope should not be introduced close to prevent laparotomy scars. Difficulty may be experienced in getting an adequate air space in cases of adhesive tuberculous peritonitis. In such cases, the peritoneoscope may be introduced directly into the bowel with a fatal result. ¹¹

Complications.—**Biopsy.** Careful attention to technique. bleeding. Coagulation of the wound with diathermy may help to prevent serious hemorrhage. In my series of 747 peritoneoscopies, fatal hemorrhage has occurred only once and that was in a case of advanced carcinoma of the liver in a very debilitated patient where death occurred 12 hours later. ¹² Gross blood was found in the peritoneum. This is another complication which may lead to a fatal result.

carried out.

may be immediately

Technic.—The instrument designed by Ruddock¹³ has proved very satisfactory. Under novocaine anesthesia a 1 cm incision is made usually in the midline but in any event to avoid previous laparotomy scars and carried down to the peritoneum. A small blunt trocar is then introduced into the

examination should be carried out in a systematic manner and should include both lobes of the liver, abdominal peritoneum, tumor masses if any pelvic peritoneum and pelvic organs. Changes in the position of the patient may be helpful including Trendelenburg, reverse Trendelenburg and side-elevated positions. An assistant's examining finger in the rectum or vagina may aid in the examination.

Liver Disease.—In a series of 435 peritoneoscopies, Benedict¹⁴ reported that the examination was undertaken primarily to study the liver in over two-thirds of the cases. One hundred and seventy patients were found to have metastatic carcinoma, seventy three had cirrhosis, and the remainder had various diseases involving the liver. Probably the most important single use of the peritoneoscope is to positively establish a diagnosis of metastatic carcinoma. This may have been primary almost anywhere in the body, but common primary sites include esophagus, stomach, pancreas, colon, rectum, breast, lungs and prostate. In cases of carcinoma of the stomach without



Fig 372 (E F, M G H No 292138)—Metastatic carcinoma of pelvic peritoneum demonstrated by peritoneoscopy. Primary carcinoma of stomach.

pyloric obstruction laparotomy will be contraindicated if metastatic disease is found in the liver or peritoneum (Fig 372). Similarly in cancer of the colon or rectum when obstruction is not present or imminent, the demonstration of metastatic carcinoma may save a laparotomy. Many such patients have no obvious site for their primary tumor, and thus peritoneoscopy may save a great deal of time in diagnostic study. In spite of the reports of very radical surgical removal of parts of the liver, it is difficult to believe that these are ever curative or even justifiably palliative.

In addition to primary or metastatic carcinoma of the liver, other causes of hepatomegaly may require investigation by peritoneoscopy

I refer to cirrhosis, hepatitis, sarcoma, lymphoma, echinococcal cyst, polycystic liver, and sarcoid. In this hospital when there is little or no

liver parenchyma to give adequate microscopic diagnosis. If, however, carcinoma is suspected, it will be advisable to make a direct inspection of the liver with the peritoneoscope in order actually to see



Fig. 373 (T. C. M. C. H. No. 434957) — Toxic cirrhosis with marked liver atrophy in a 68 year old male with long alcoholic history, jaundice and ascites. Gallbladder in foreground appears relatively large due to very small size of liver. The question of malignancy was raised clinically but cirrhosis only was found by peritoneoscopy.

the liver surface and select the proper site for biopsy. On some occasions, the differential diagnosis between infectious hepatitis and gallbladder disease may be difficult. Peritoneoscopy with biopsy of the liver may make a positive diagnosis of infectious hepatitis and thus avoid an unnecessary exploration for gallbladder disease.

Ascites — A considerable number of patients present themselves with a chief finding of abdominal fluid. Having ruled out the heart and kidneys, one may still be in doubt as to whether the ascites is due to cirrhosis (Fig. 373), carcinoma or tuberculous peritonitis. The correct

diagnosis may be readily established by pentoneoscopy with biopsy. Biopsy will be extremely important in a considerable number of cases as the multiple tiny implants from carcinomatosis may closely simulate in the gross appearance the tubercles from tuberculous peritonitis. Papillary ovarian carcinoma commonly metastasizes widely throughout the abdominal and pelvic peritoneal cavity. By peritoneoscopy it will usually be possible to determine the exact extent of the metastases and the possibility or impossibility of a palliative resection. When metastases are widespread, palliative resection will usually be contraindicated. Occasionally it will be very difficult to determine by physical examination whether one is dealing with ascites, ovarian cyst or other large cystic abdominal tumor. Peritoneoscopy will be helpful in such cases.

Jaundice—Jaundice is a frequent presenting symptom and may be present in toxic cirrhosis, biliary cirrhosis, carcinoma, or hepatitis. Some of these patients are elderly and very ill. Laparotomy is to be avoided if possible. Peritoneoscopy with biopsy of the liver may result in a positive diagnosis and the avoidance of an exploratory operation. The prothrombin time should be determined in all cases of jaundice before peritoneoscopy. If the prothrombin time is elevated, adequate doses of vitamin K must be administered.

Peritoneoscopy is not indicated in the acute abdomen. In fact an acute infectious process in the peritoneal cavity is a contraindication to the introduction of the peritoneoscope. In exceptional cases, however, one may suspect a tumor mass but find on peritoneoscopy some type of infectious process. A palpable mass in the pelvis, for example, may turn out to be subacute or chronic salpingitis. A lower abdominal mass may prove to be multiple adhesions from a subacute or chronic appendicitis. In one case of acute pancreatitis, peritoneoscopy demonstrated multiple pale, yellowish implants from which a biopsy was obtained which showed fat necrosis.

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EARLY DIAGNOSIS OF UTERINE CANCER BY VAGINAL SMEAR

MAURICE FREMONT-SMITH, M D * AND RUTH M GRAHAM, B S †

WE are told that 1,500 000 men and women today walking the streets of New York are destined to die of malignant disease. Of the women, uterine malignancy will kill the largest number. Seventeen thousand women die each year in the United States of uterine (16 000 of breast) cancer. These women die, for the most part, because a diagnosis is made too late. The reasons for the delay in diagnosis are first, insufficient public education, second, inadequate medical education and third, the apparent need for undergoing a complicated procedure (biopsy) before, in certain cases, the presence of cancer may be even suspected.

The vaginal smear test^{1 2 3} for the early diagnosis of uterine cancer may save many women otherwise condemned to die. A drop of vaginal secretion is obtained by passing a glass pipet to the posterior fornix of the vagina. Suction is applied by means of an attached rubber bulb. The secretion is blown on a glass slide, stained and examined for cancer cells. Criteria for the recognition of cancer cells are given in the references quoted.

We have recently seen a woman of 45 symptomless except for hot flashes. A supravaginal hysterectomy had been performed five years before. The cervix looked and felt normal. A routine vaginal smear was reported positive for cancer. On the excised cervix one diagnosis only: chronic cervicitis. To review the slides, He made an unequivocal diagnosis of carcinoma in situ.

Another illustration is this case reported through the courtesy of the Commonwealth Fund Study. A woman of 40 appeared in the Westfield State Hospital *without gynecological complaint*. A routine vaginal smear was positive for cancer. A biopsy taken at the time of the first smear showed epidermidization of glands. Biopsies taken two and three months after the smear were negative. Biopsy eight months later showed epidermoid carcinoma.

Neither of these two women was suspected of harboring cervical cancer until vaginal smears were examined. In neither was a diagnosis

From the Vincent Memorial Hospital (the Gynecological Service of the
f Medicine and Gynecology)

made by examination of the fixed tissue specimen even after the smears were known to be positive. The biopsy remains without question the final diagnostic test. It has not been our policy, except in a few cases, to operate on the basis of a positive smear without biopsy confirmation. The vaginal smear has become, however, a necessary complement to the biopsy. The report of a positive (or doubtful) vaginal smear facilitates and hastens the obtaining of biopsy specimens. It is well known that the biopsy may miss a very early cancer because the involved area may be too small to visualize or may lie in the endocervical canal. Moreover, the biopsy specimen may be so sectioned in the laboratory as to show no epithelium—a technical fault not easy to obviate, especially in small punch specimens. Cancer, under these circumstances, *can be neither diagnosed nor excluded*. These factors limit the usefulness of the biopsy in the detection of early cancer.

The smear, on the other hand, is not limited to the examination of a small area but contains cells desquamated from the entire surface including the endocervical canal and the endometrial cavity. Certain limitations, however, also apply to the smear method. First, in some carcinomas, especially those arising in the endometrium, cells which can be recognized as malignant are not found. Cancer cells, moreover,

Thus false positive reports may be made. Accurate diagnosis by this method requires training and experience.

In our series of 3720 cases to date, we have studied 285 proven carcinomas of the cervix. The vaginal smear was positive in 254. Thus mistaken negative diagnoses were made in 31 or 10.8 per cent. Of ninety-eight cancers of the endometrium, negative diagnoses were made in twenty—an error of 20.4 per cent. Of the 3327 cases without cancer, a mistaken positive diagnosis was made fifty-five times—an error of 1.6 per cent.

Judged in relation to other laboratory tests, the vaginal smear is accurate. An occasional positive Wassermann in a nonsyphilitic or the converse does not invalidate the Wassermann test. Absence of

greatest value in the screening of large numbers of women for cancer as the tuberculin test is used to screen for tuberculosis.

Over the past five years, seventeen women with proven intraepithelial carcinoma of the cervix were studied in the Vincent Memorial Laboratory. Initial vaginal smears were positive in fifteen. Perhaps

because in early cases less tumor necrosis has occurred, cancer cells are more consistently found in the vaginal smear where small carcinomatous lesions are present than in advanced cases. The method is thus most applicable to just that group for whom a diagnosis offers most hope. The vaginal smear is an important complement to the biopsy in the diagnosis of early cancer of the uterus.

SUMMARY

The vaginal smear method of diagnosis is of great value in cancers of the female genital tract.

The smear technic is very successful in picking up early and even intraepithelial lesions.

Early diagnosis makes cures of cancer possible and this method is therefore an essential part of gynecological diagnosis.

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A CASE OF MALE PSEUDOHERMAPHRODITISM THE IMPORTANCE OF PSYCHIATRY IN THE SURGERY OF THIS CONDITION

FRANCIS M INGERSOLL M.D.* AND JACOB E. FINESINGER M.D.†

This report deals with a case of male pseudohermaphroditism the second¹ studied at this hospital in the past five years. The gonads of this patient were male while the external sex characteristics were female. We are following the classification of Young² who applied the term "male pseudohermaphroditism" to a condition in which the primary sex glands are male in spite of the presence of many feminine secondary sex characteristics. This differs from true hermaphroditism which as defined by Creevy³ should be limited to individuals having germinal cells of both sexes irrespective of the nature of the external genitalia or secondary sex characteristics. Cases of adrenal and pituitary hyperplasia, gynecomastia, arrhenoblastoma and teratoma of the testes which cause alterations in the secondary sex characteristics are to be differentiated from pseudohermaphrodites. This condition is considered congenital. O'Farrell⁴ has reported the history of a family in which five of forty children from six siblings were pseudohermaphrodites.

The diagnosis depends upon two essentials: the histology of the gonad and the character of the other genitalia. The histology of the gonad can be determined only by biopsy at operation. Inspection of the external genitalia alone does not give sufficient information for a decision to alter a male pseudohermaphrodite. Case 5 in Young's series illustrates this point. This patient was raised as a boy until the

vagina
† gonad
and the
as a girl

Case History.—A 15 year old white single patient J. E. S. (M. G. H. No. 10350) The
of

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Psychiatry Massachusetts General Hospital

had an erection of the clitoris or penis. There was no family history of mental disease, pseudohermaphroditism or endocrine abnormalities. Her early development was normal. She had the usual childhood diseases. She began school at 4 and when first seen at the age of 15 she was a junior in high school.



Fig 374

Fig 374—Patient in November 1943. Note male physique and lack of breast development before treatment.

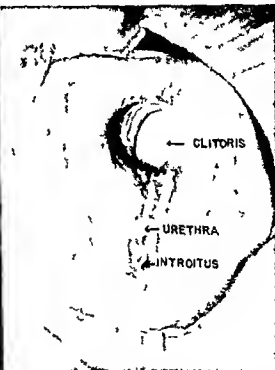


Fig 375

Fig 375—Patient in April 1946 showing penneum, enlarged clitoris, female urethra, intact hymen and introitus.

Physical Examination—This disclosed a young white adult whose general body contour was that of a young male—5 feet 7 inches tall. The chest was

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The diagnosis depends upon two essentials: the histology of the gonad and the character of the other genitalia. The histology of the gonad can be determined only by biopsy at operation. Inspection of the external genitalia alone does not give sufficient information for a decision to alter a male pseudohermaphrodite. Case 5 in Young's series illustrates this point. This patient was raised as a boy until the age of 7. At that time he was seen because of hypospadias, a vagina

Case History.—A 15 year old white single patient J. E. S. (M. G. H. No. 422659) was admitted to the Massachusetts General Hospital complaining of the absence of menses, lack of breast development and a low pitched voice. The

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Past History.—The patient was the third of four children in a middle class family of Scandinavian descent. When the patient was born the obstetrician said that she was a boy. Ten minutes later, he decided that she was a girl. Thereafter the patient's development was that of a girl. As a child the patient had whooping cough, chickenpox, mumps at the age of 12 and measles at 13. There were no unusual neurotic traits in childhood. Three years before admission her voice became deep and her clitoris began to enlarge. The patient grew to 5 feet 7 inches, she did not menstruate and her breasts showed no signs of development. She first noticed the change in her voice when she was 13, but does not remember how long it took for her voice to change. When I first noticed it, I didn't think much of it and I hoped and thought that it would disappear. Then I finally got used to it. Once in a while I was mistaken for a man or boy on the telephone. My friends and family never talked about it. I knew my voice was low and I felt upset. My voice was not like that of other girls, her clitoris was enlarged, other girls. This shows with a skirt for the morning, and mentioned having an erection on seeing the picture of a nude girl. There were no dreams or fantasies associated with the erections, she states. She did not think much about this and did not talk to anyone about it. I didn't like it, but I didn't worry about it. I knew it shouldn't be that way. I was more like a boy. Her lack of menstruation and breast development worried her.

Social History.—The patient remembers little of her childhood until she was 10. More intensive focusing on her early life revealed several memories. She recalls playing with dolls until about the age of 10. In these games she was the mother and always assumed a feminine role. Occasionally she played with animals and mechanical toys. Her sister was more vain and liked to primp whereas the patient did not. She was a homebody. When her mother had a job away from home she took over her duties and was concerned with the girls and she describes she had four intimate was too young to go on casual dates with boys. She goes to lunch and the movies with her friends and feels natural in the role of a girl. Occasionally she goes to mixed dances. She enjoys dancing with boys and at times feels sexually aroused by them.

Personality.—The chief characteristics are calmness and dependability. She has a trustworthy nature and seems mature for her age. The patient spends an abnormal amount of time at home taking care of the household. She has always been considered bright and intelligent by her parents. She is sensitive socially, but is outgoing and tends to be extraverted. She is a leader of an athletic club at school and readily assumes the role of a leader or of a follower. Her self estimation is modest. She is considered adaptable and stable. Her mood is characteristically one of contentment and she often reassures her mother when the mother is worried. She is moderately artistic, copying various types of lettering. No recent character changes have been noticed.

Fantasy Material.—The patient has always considered herself a female and up to the onset of the present illness had no problems as to her sex. She was fond of her father, but at times was jealous of which fantasized the She states that at this topic. When her voice changed, people

no prepuce and no urinary meatus. The labia majora were large, the vagina was 2 inches in depth, the hymen was intact, the urethral meatus opened just above the introitus in the normal female position. The uterus was small, and no ovaries could be felt (Figs 374, 375).

Laboratory Examination.—On laboratory examination the blood and urine were within normal limits. The blood flint test was negative, the basal metabolism was plus 4. X-ray of the bones demonstrated a bone age of 16 or 17. The electroencephalogram was normal.

Hormonal assays on admission showed that the urinary 17 ketosteroids ranged from 2.6 mg. to 10 mg., with an average report of 5 mg. per twenty-four hours. The follicle-stimulating hormone assay was positive for 6.5, 13, 26, and 52 mouse units and negative for 104 and 208 mouse units per twenty-four hours. These values fell within the normal female range for this test in premenopausal patients.

Summary of Mental Status.—The patient's behavior was a little shy and retiring. Speech was not unusual excepting for the deep voice. The mood and the content of thought were normal and the orientation was correct. Memory was excellent in all fields and general information was adequate. Judgment and insight were good in practical and theoretical fields. The intelligence quotient was 117.

Operation.—Ether examination and a laparotomy were performed on October 20, 1943, by Dr. Joe V. Meigs. The gallbladder, liver, spleen and kidneys were normal. The appendix was in its usual position and was removed. Inspection of the pelvis showed the patient to have a small uterus the size of a gulf of 12. Both tubes were normal. There was a gonad in the position of the right ovary.

than in the usual cryptorchid. The left gonad consisted of dense fibroblastic and collagenous tissue but in it were embedded a few lumenless "tubules" similar to those seen in the prepubertal testes. No Leydig cells could be identified. The decision on the operating table was to biopsy the gonad rather than remove it.

Psychiatric Studies.—The next step was to admit the patient to the psychiatric service for psychiatric study. By such a study the true nature of this patient's sex could be determined. The patient was studied in the Psychiatric Ward and is being followed at present. She has had seven ward admissions. On her second admission she was interviewed for twenty-eight periods, during which free association was used to obtain more details about her fantasy life. The patient did not talk readily and had to be prompted considerably. Great care

patient's predominant feelings and orientation were feminine, an attempt was made to initiate menstruation and breast development by medication with stilbestrol. One milligram a day was ineffective in starting menstruation. However, she reported occasional light headaches, tenderness about the nipples with no increase of fullness and no tingling, more profuse sweating under the armpits, and a decrease in



Fig 376



Fig 377

Fig 376—Patient in April, 1947. Note enlarged breasts and darkened areolae after stilbestrol therapy.

Fig 377—Note acceptable female appearance after therapy.

the number of erections. Six days after the stilbestrol was discontinued, she complained of hot flashes with flushing. At this time two determinations of keto steroids were 2.6 and 3.6 mg per twenty-four hours, which represented lower values most likely due to the medication. It was decided to increase the stilbestrol to 2 mg for twenty-eight days and then omit it for ten days. This regimen was continued. During the next eighteen months the menstrual flow became regular.

would notice these abnormalities. She knew that her voice was like that of a boy's, yet she never fancied herself as a boy. These were abnormalities in a girl which were to be corrected. Vocationally she wanted to be a nurse or a secretary. At present she fantasizes meeting boys, kissing them, and at times thinks of having intercourse with her future husband. These ideas appear at times during masturbation. Her fantasy life is neither active nor intense. However, in it she assumes the passive role, and identifies with her mother and other females.

Attitude toward Problem.—Both the mother and father felt that since the patient had been reared as a girl, she should remain a girl. Her friends and relatives considered her a female and hence it would be a mistake to attempt

state that he absolutely did not think he could be home and receive the patient were she to return from the hospital in boy's clothing.

The patient wanted to remain a girl. Her tastes, interests and personal emotions had always been those of other girls. The idea of intimate relations with

the same thing." After three years of stilbesterol, her breasts developed. This pleases her. She is also grateful for the operation which removed her clitoris. "I'm glad it turned out the way it did. I'm more suited for a girl."

Summary of Psychological Studies.—A battery of psychological tests was administered to the patient during her first and second admissions. These included the Wechsler-Bellevue Intelligence Test, the Rorschach and Thematic Apperception Tests, the Bernreuter Personality Inventory, the Minnesota Multiphasic Personality Inventory, and the Form A of the Terman Miles Attitude Interest Analysis Test.

Her intelligence was well above normal and the personality tests showed a deviation in the direction of femininity. The projection tests indicated that the patient was an adolescent with an overprotective mother and a harsh father. There is evidence of immaturity, passivity, and a tendency to avoid unpleasant social situations. The mother figure is idealized and there is a strong desire for neatness, compliance and good relationships with girls. She identifies with the mother and shows no need for competing with males. The female qualities of neatness, orderliness and compliance are seen as desirable and leading to success. She wishes to be a woman and accepts the feminine role. The conclusions drawn from the test battery reinforce the clinical opinion that the patient has socialized in a feminine pattern of behavior with which she identifies. She rejects striving and masculine attitudes. There is agreement among the various tests in that the patient's personality is definitely feminine.

Subsequent Course.—Because our studies indicated that the pa-

tients predominant feelings and orientation were feminine, an attempt was made to initiate menstruation and breast development by medication with stilbestrol. One milligram a day was ineffective in starting menstruation. However, she reported occasional light headaches, tenderness about the nipples with no increase of fullness and no tingling more profuse sweating under the armpits and a decrease in



Fig 376



Fig 377

Fig 376—Patient in April 1947. Note enlarged breasts and darkened areolae after stilbestrol therapy.

Fig 377—Note acceptable female appearance after therapy.

the number of erections. Six days after the stilbestrol was discontinued she complained of hot flashes with flushing. At this time two determinations of keto steroids were 26 and 36 mg per twenty four hours which represented lower values most likely due to the medication. It was decided to increase the stilbestrol to 2 mg for twenty-eight days and then omit it for ten days. This regimen was continued. During the next eighteen months the menstrual flow became regular.

and the frequency of erections decreased. The breasts became enlarged and the nipples and areolae became darkly pigmented. Figure 370 illustrates the striking change in the breast. This breast development occurred as a response to estrin therapy even though testosterone was still being secreted. The urinary keto steroids varied from 35 to 54 mg. each twenty four hours. The clitoris continued to enlarge. Because of the decision to keep the patient a female, the enlarged clitoris was amputated by Dr. Meigs on April 29, 1946, two and a half years after the original operation. Removal of the testicle was postponed in order to avoid castration which might have precipitated the disturbing physical and mental symptoms of the menopause, although with modern substitution therapy these menopausal symptoms could be controlled. However, she seems to be progressing satisfactorily. Since clitoridectomy for periods of two years, menstruation has been normal and adjustment has been satisfactory.

Comment.—A similar case of male pseudohermaphroditism with a psychoanalytic study was reported by Finesinger, Meigs and Sulko-witch.¹ In this case, too, from the anatomic point of view the patient was masculine and from the endocrine point of view the patient was a normal male except for the cryptorchidism. In spite of the anatomic and endocrine point of view, the psychological evidence demonstrated the patient to be feminine. She too was not castrated and was allowed to remain a female.

Novak² had a similar case—a college girl aged 19 who had been looked upon as a fairly normal girl. She failed to menstruate. Her instincts were typically feminine with well marked libido toward males and frequent turgidity of the "clitoris" which was enlarged. This patient had normal labia majora and minora, a normal hymen and a vagina 35 cm. in depth. At laparotomy two testes were found and removed and a clitoridectomy done. Novak says in discussing this serious problem, "In spite of the microscopic characters of the gonads (male) there was no question that the patient should be allowed to continued life as a female. Aside from her dominantly female characteristics and female psychology, the external genitalia were of the normal female type, except for the overgrown clitoris and rudimentary vagina. Following the operation she reported an improvement in general attitude and her instincts continued to be strongly feminine. She did require estrin therapy."

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sonality and the sexual behavior were feminine, yet the structural and endocrine features were essentially masculine. The evidence indicates that situational and cultural factors played the significant role in the patient's emotional development. Psychiatric and psychological study can define the sexual and social orientation of the patient. Once this is established, the surgeon can transform the external genitalia to fit the psychosexual behavior of the patient.

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ENTEROCELE OR POSTERIOR VAGINAL HERNIA

JOE VINCENT MEIGS M D F A C S *

AN enterocele is a posterior vaginal hernia. This hernia in the truest sense is not a prolapse of the posterior cul de sac either primary or following a vaginal, a subtotal or a total hysterectomy. It has generally been considered that a bulge in the posterior vaginal mucous membrane that is above and not part of a rectocele is due to a pushing down or prolapse of the posterior cul de sac. Careful observation during the past few years has not revealed any hernias due to prolapse of the cul de sac that should be considered as enterocele. Unquestionably this sort of prolapse occurs following the above operations but it is more and more evident that this prolapse should not be considered as a true enterocele.

If a deep posterior cul de sac progresses and prolapses far enough the result should be a prolapse of the anterior wall of the rectum through the anus. Graham¹ in 1942 at the meeting of the American Surgical Association showed by means of moving pictures the proper evaluation of massive rectal prolapse. It was evident in his case that the anterior rectal wall prolapsed through the anus. At operation it was clearly demonstrated that this was due to an invagination of the deep cul de sac into the rectum and out through the anal ring. This then is the usual and expected end result of an elongated cul de sac of Douglas. In a few instances a deep cul de sac may lie upon the rectum and may present as a large rounded bulge on top of the rectum behind the posterior wall of the vagina and create a large wide bulging hernia. This lesion may be called an enterocele for sigmoid or small intestine may be present in it. However it is our experience on close observation that although this might appear to be the usual cause of enterocele as we know it it really is not. We believe that a true

vaginal septum. This lesion must be suspected before and looked for at vaginal examination as it can be easily missed. A vaginal bulge complained of before operation and present just as soon as the patient gets out of bed after repair of a so-called rectocele is usually such an enterocele. This bulge is a real hernia and its sac has a small neck is made up of very thin peritoneum and often contains small intestine.

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During vaginal or supravaginal hysterectomy, and even total hysterectomy, this sac can be easily overlooked. It has its origin directly behind the cervix, between the uterosacral ligaments. Such hernias and very early types of such hernias, before they have bulged into the recto-vaginal septum, can be recognized at operation by palpation and inspection of the area between the uterosacral ligaments directly behind the cervix. It is our custom at operation to lift the uterus high and forward and to observe and to palpate with the forefinger the area between the uterosacral ligaments. Often a small dimple, ring or a $\frac{1}{4}$ to $\frac{1}{2}$ inch herniation will be found here. This is the incipient enterocele. Others have been encountered that admit the forefinger for at least an inch and a few have been found that are deeper than that. Inasmuch as the Vincent Hospital group does the abdominal part of the total hysterectomy and perineorrhaphy first and repairs the perineum later, it is obvious that small or large hernias would be discovered. It has been noticed when an enterocele is known to be present and operated upon from below that the very thin walled sac leads to an area directly behind the cervix. During the vaginal part of the operation the sac is tied off with a purse string suture and then it is our custom to do an abdominal operation. At the abdominal part of the operation the sutures that tied the enterocele off from below are found to lie directly between the uterosacral ligaments. The cul-de-sac is below and not connected with the enterocele. It is clear therefore that this type of hernia, true enterocele, is not a prolapse of the cul-de-sac of Douglas but a separate well defined sac that leaves the peritoneal lining of the pelvis between the uterosacral ligaments and behind the cervix. Small rings and incipient hernias are common. At operation the peritoneum of the area between the uterosacral ligament is closed by suturing the ligaments together and obliterating the area between them with a continuous catgut suture. This suture is carried to the depths of the cul-de-sac.

up and onto the upper rectum or carried back again to the origin of two layers of sutures to close the defect in the peritoneum. This often means closing in a good portion of the cul-de-sac but always obliterating the area between the uterosacral ligaments.

The reason for posterior vaginal hernia that occurs following vaginal hysterectomy when the surgeon has closed the cul-de-sac is obvious. When during vaginal hysterectomy the peritoneum is opened and a finger is placed in the cul-de-sac at the posterior peritoneal opening a deep area may be found. This cul-de-sac is closed by suturing the uterosacral ligaments together deep into the cul-de-sac. In some instances a small enterocele will be inadvertently obliterated. If the cul-de-sac suture does not happen to include the true enterocele opening the enterocele may be entirely missed and the opening not

closed. Later the enterocele will be found and will be considered as due to a poorly closed cul de sac. It is not difficult to see how a small opening between the uterosacral ligaments could be missed; it is hard to visualize; it collapses easily and unless definitely looked for will be overlooked. There is more interest in the closure of the deep cul de sac which is not the source of the hernia. It is extremely important for the operator to note if there is any suggestion of an enterocele sac lying upon the rectum just behind the cervix and to try to place the index finger in the area just between the uterosacral ligaments. He should not be satisfied with a deep cul de sac if there is a posterior vaginal bulge. Investigation of this area during vaginal hysterectomy and observation of the posterior peritoneum and cul de sac at subtotal or total hysterectomy will often disclose a weakness of the peritoneum in this region and closure of this sac or ring will prevent the occurrence of an enterocele after operation.

DIAGNOSIS

There are various methods advocated for the diagnosis of enterocele but the most satisfactory method is simplicity itself. The patient should be examined in the standing position and she should squat or strain down while the examiner's finger is in the rectum and the thumb in the vagina. This method forces air, fluid or intestine into the hernia. The hernia can be easily compressed and it can be definitely noted that the lesion is not a rectocele but a bulge in the rectovaginal septum. Other methods are advocated with the patient in lithotomy position; the larger type of enterocele can be recognized in this way but some are missed. Examination with the patient standing is much the best and fewer enteroceles will be missed if this method is made a part of the routine of vaginal examination. It is discouraging to operate upon patients for any type of pelvic surgery and later to have this annoying entity develop. Enterocele can be missed completely at operation. That this is not uncommon can be attested by the fact that many enteroceles are found after operation. It is erroneously considered that the reason for the enterocele is a prolapse of the cul de sac. It is not realized that the most frequent cause is an unrecognized enterocele or an incipient one that has progressed to larger proportions.

THE OPERATION

The operative cure of this lesion should consist of a careful dissection of the posterior vaginal wall with careful search for a small thin sac lying just behind the posterior vaginal wall and upon the rectum. This sac once recognized can be easily dissected up to the region behind the cervix. The sac is freed and a purse string suture is placed inside the sac and tied. It is often possible to reinforce the

purse string suture by placing a transfixion suture in the extra peritoneum left after the sac is cut free. This procedure may suffice but it is the habit of the author to do an abdominal exploration to observe the suture line and to reinforce it. The suture line is always found behind the cervix between the uterosacral ligaments. The closure has not always been perfect and the addition of careful sutures in the peritoneum from within gives it strength. A deep cul de sac may be present but this is not the enterocele and gives no symptoms at all. It is our conviction that the deeper the cul de sac the more likelihood that there will be a prolapse of the anterior wall of the rectum through the anus rather than a posterior vaginal wall hernia or the so-called enterocele. The cul de sac of Douglas enterocele does exist but in no case have we repaired an enterocele from below and found at abdominal exploration that it was the deep cul de sac with which we were dealing. The area of the exit of the true enterocele has always been between the uterosacral ligaments and behind the cervix.

CONCLUSIONS

1. In the early stage of the disease, it is through this opening that the contents of the pelvis can prolapse and bulge in the rectovaginal septum.
2. The enterocele is best recognized with the patient in the standing position. The examiner should have the index finger in the rectum and the thumb in the vagina. On straining or squatting a bulge will occur between the fingers that should be obvious to the examiner as the leading part of a true hernia and not a rectocele.
3. Recognition of an enterocele leads to the obvious surgical approach: dissection of the sac from below and a purse string closure and reinforcement from below. Abdominal exploration and reinforcement of the suture line from the inside is of great value.
4. Prophylactic closure of deep or bulging areas behind the cervix and between the uterosacral ligaments should help prevent the development of such true hernias after such operations as vaginal subtotal and total hysterectomy.
5. The recognition of the hernia at the time of original operation will often prevent the operator from considering that his faulty closure of the posterior cul de sac has subsequently allowed a prolapse of the cul de sac and the formation of the enterocele to develop. Most of these lesions are true enteroceles and careful consideration of this problem will disclose the anatomical defect to the operator.
6. Prolapse of the rectum is a herniation of the deep cul de sac into the anterior rectal wall with protrusion of the anterior rectal wall.

through the anus. This is a *separate surgical* entity and should not be confused with enterocele.

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CANCER OF THE CERVIX. OBSERVATION ON THE EFFECT OF X-RAY THERAPY ON REGIONAL NODES

LANGDON PARSONS, M D, F A C S *

THE problem of the proper management of carcinoma of the cervix has always been an intriguing one, for it has never remained static. In recent years, as the results from the accepted form of treatment through x-ray and radium are known, the problem of treatment again comes up for reevaluation. However much the survival statistics improve and eventually level off, the fact remains that too many patients die of the disease despite our best efforts to control it through early detection and more effective therapy. The challenge of the disease remains to mock us, for patients with cancer of the cervix die for the most part with their disease sharply confined to the pelvis. To be sure, certain patients, usually with Grade III lesions, will die of remote metastases to lung and bone, but by far the greater number will come to a terminal issue with extensive disease in the pelvis alone.

While the established form of therapy in vogue through the past fifteen years, employing x-ray and radium in combination, has produced a marked improvement in survival rates for cancer of the cervix, the unfortunate fact still remains that at best one of every two patients will die of their disease, and more commonly a salvage of one out of three is the rule. It is not surprising then that a critical eye has been turned upon the accepted form of therapy.

THE BACKGROUND OF PRESENT TRENDS IN THERAPY

To better understand the present trend of thought it might be well to briefly sketch the background of previous attempts at therapy.

Before the advent of radium the profession placed its chief reliance for the eradication of the disease upon surgery. Radical surgery as advocated by Wertheim and championed by Bouney called for extensive abdominal attack. The entire uterus and adnexa were removed together with generous segments of the parametria, rectovaginal septa and vagina itself. Schauta attempted to approach the same problem by his radical vaginal operation. The measure of success from these procedures was in part due to the extent of the disease, modified by the technical skill of the operator, as manifested by his operative mortality and morbidity. Chemotherapy and the modern conceptions of fluid balance and blood replacement had not yet made their appear-

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ance, and the mortality figures in the early days were formidable enough so that any addition to the medical armamentarium, such as radium, which introduced an element of hope of cure while reducing the mortality incident to treatment, was certain to be warmly received.

Radium came into general use in most clinics throughout the country to supplant surgery in 1918 to 1920. The initial enthusiasm was more than justified when the overall salvage increased from approximately 14 per cent to about 20 per cent with no initial mortality attributable to its use. However, attempts to increase the dosage of the local application of radium to handle the extension of the disease beyond the cervix resulted in a marked increase in morbidity and some increase in mortality as extensive fistulas were produced. It became apparent that while radium would effectively cure cancer of the cervix in a high percentage of cases when the disease was confined to the cervix, it was less effective when the parametrium and regional nodes became involved. Inasmuch as approximately 80 per cent of the cases of cancer of the cervix have extended beyond the confines of the cervix when first seen, it was soon evident that radium needed some support if the disease were to be effectively controlled. The 20 per cent five year survival figure bettered anything yet offered, but still 80 per cent of patients died of their disease.

With the introduction of external radiation in the form of x ray therapy, hope was introduced that distant disease beyond the scope of radium, either in the parametrium or in the more distant nodes, might be eradicated or held in abeyance. Again the initial enthusiasm was borne out by the improvement in the five year survival statistics which jumped from the 20 per cent average salvage figure for the use of radium to a more respectable figure of 35 per cent for the combined use of x ray and radium.

The mortality incident to its use remained negligible but effective treatment was not without its early morbidity manifested by roentgen sickness and radiation proctitis nor its late morbidity in the form of radiation stricture of adjacent bowel and the radiation reaction in the skin of the portals of delivery. Thus the problem became one of delivering a more effective cancerocidal dose at the site of the tumor.

Improvements in technique have resulted in less scattering of radiation upon the skin and a more effective treatment of the disease with less damage to adjacent structures, such as bowel and bladder. If improvement in the survival statistics was possible with the lower voltage x ray machines, perhaps a greater salvage might come from apparatuses designed to step up the voltage. Hence the development of the 400 000 volt x ray machine, the million volt machine, and now the experimental use of the three million volt x ray. As the natural course of the disease in its lymphatic spread became better known, different fields for the introduction of effective x ray treatment have

been tried in the attempt to deliver the proper dosage to the tumor and the common sites of extension of the disease, such as the iliac and obturator areas. Thus the vaginal cone technic has been advocated by Behney. Attempts to attack the obturator nodes more effectively were made in a number of clinics with the result that necrosis of the femoral heads was not an uncommon sequela, resulting in lessened enthusiasm for the use of this portal of entry. All clinics were in agreement that x-ray treatment will not suffice, and the use of radium is generally conceded to be the basic requirement for therapy with x-ray employed as a supplement.

PRESENT TRENDS IN TREATMENT

Increasing attention is now being directed toward a more intelligent application of radium. The availability of platinum in all lengths and strengths for interstitial use has heightened the interest in methods to deliver a more effective dose of radium. There is still a tendency to make the disease fit the type of applicator available, rather than a more intelligent application of radium to the disease. The dosage tends to remain standardized regardless of the extent of the presenting disease. There is much to learn and improvement in results may still be expected.

The survival figures continue to improve, but the initial progress has not been maintained and the final survival rate from the combined use of radium and x-ray by whatever means employed has apparently come to a plateau. The statistics from the various clinics vary, depending upon the type of material, measured by the extent of the disease, that is presented to that clinic. If, for example, an alert medical profession and cancer-minded public produce more cases in the early stages of the disease a higher over all cure rate may be expected. It is only natural then that there is an increasing enthusiasm for early detection of the latent case of carcinoma of the cervix. Hence the wide spread employment of the vaginal smear. Nevertheless approximately 60 per cent of the patients with cancer of the cervix die.

Examining the possible explanations as to why we are unable to salvage a higher percentage of these patients who for the most part die of the disease confined to the pelvis two possibilities immediately stand out.

To any one conversant with the problem, the existence of the case seemingly resistant to radiation, whether employed as radium alone or radium plus x-ray, is well known. Until recently time alone was the judge of the effectiveness of the radiation. Mrs. Ruth Graham, reporting in the February 1947 issue of *Surgery, Gynecology and Obstetrics*, has suggested that the biological effect of x-ray may be evaluated by a consideration of the vaginal smear during the course of x-ray treatment given as a preliminary to the final interstitial radium treatment.

Those indicating a poor response to radiation as exhibited by the type of cell will be dead. Those showing an excellent response may expect to survive. It is possible then that we may have a guide toward a more intelligent adaptation of our patient to the type of therapy available and we need not subject her to a treatment doomed to failure from the start. The fact remains that with the accepted form of therapy x ray plus radiation a certain percentage of cases treated will be resistant to radiation.

The second possible explanation of our failure to cure patients is less of an observed fact than a controversial question. This has to do with the effectiveness of x ray therapy in dealing with the extension of the disease to regional nodes deep to the surface of the skin namely in the iliac and obturator areas. An increasing amount of evidence accumulates to bring the effectiveness of x ray treatment for other than the local lesion under a serious cloud of doubt.

Questioning the effectiveness of x ray in the cure of regional nodes involved in disease and knowing that certain cases will be resistant to

gional nodes as advocated by Taussig. Thus he has performed both a Wertheim and bilateral Taussig lymphadenectomy on over one hundred patients with cancer of the cervix without a death. The cancer in situ cases have been excluded and all are frank invasive cancer. This is a commendable accomplishment indicating that with modern surgery and its adjuncts chemotherapy and blood replacement together with a better knowledge of postoperative physiology a far more radical concept toward the treatment of the disease may be entertained. In this series the indications for surgery have been sharply drawn. The disease must have been confined to the cervix and adjacent vaginal wall. The patient must have been a good surgical risk as well as relatively young and thin. The surgery then is of the most radical type on reasonably favorable cases. The indications for the radical surgical approach may now be extended to include more advanced stages of the disease particularly in that group which may prove to be radiation resistant as indicated by the vaginal smear. For this group surgery alone holds a hope of cure. An increased mortality and morbidity must of course be accepted.

There remain a large group of cases 70 per cent perhaps who may still not fit into this program. Dr. Ira T. Nathanson has suggested a surgical approach which is in the experimental stage but which bids fair to occupy a definite place in the treatment of cancer of the cervix. Again it is based on the assumption that x ray treatment will not adequately care for the regional metastases in the iliac hypogastric and obturator areas. It does not tackle the problem of the radiation

resistant case. Without detracting from the accepted treatment of cancer of the cervix by x-ray and radiation, it simply adds a surgical attack on the distant nodes once a fair assurance has been obtained that the local disease is cured. The effective part of the surgical approach to the iliac, hypogastric and obturator areas lies in the fact that because it is a retroperitoneal approach it carries with it a very slight morbidity and to date no mortality, whatever the size or surgical risk of the patient. Moreover we feel that it provides a better exposure of these areas than can be obtained from within the abdomen.

The fact that these nodes are commonly involved was definitely confirmed by Meigs who found 17 per cent of positive nodes in the cases clinically regarded as Stage I (International Classification). Of the Stage II cases 28 per cent showed positive nodes. Taussig, employing his intraabdominal lymphadenectomy, found 20 to 25 per cent of involved nodes in these areas. It is interesting to note that in the series now being carried out by Dr. Nathanson and the author 14 per cent of Stage I and 28 per cent of the Stage II have positive nodes after a complete course of x-ray and radium therapy. This consists on an average of 4500 mg. hours of radium given in interstitial needles with a central applicator containing 100 mg. of radium, supplemented by an initial 8000 r units of deep x-ray therapy given by the 200,000 volt machine, 400,000 volt machine, as well as by the one million and three million volt x-ray.

As positive nodes would seem to remain the same whether a full course of x-ray therapy were given or not.

One may argue that if these nodes are involved in disease, surgery will not cure them any more than x-ray will. Bonney with his radical Wertheim procedure cured one out of five. Meigs with a more elaborate procedure salvaged three of ten. Further confirmation may be borrowed from the dissections of this area for cancer of the vulva where eight of thirteen patients were alive three years after positive nodes were found in these areas.

In the course of this study two very interesting patients have presented evidence to raise a further question as to the effectiveness of deep x-ray therapy in curing nodes involved in disease in the iliac, hypogastric and obturator areas.

CASE I—The first patient, M. N. aged 57 presented a Stage II carcinoma of the cervix involving the entire cervix with beginning extension on the vaginal wall. Following a preliminary course of 7200 r units of x-ray therapy, employing the 400,000 volt machine, interstitial radium in the form of eight 125 mg. platinum needles was inserted in the periphery of the growth supplemented by two 50 mg. radium tubes in a central applicator in the cervical canal. Three months thereafter when both vaginal smear and biopsy failed to show per



Fig 378 (Patient M N) —Common iliac node outside the radiated field along common iliac. Normal fat and open sinusoids evident on the periphery of the node. Tumor cells with adjacent normal cells and stroma show no evidence of radiation reaction.



Fig 379 (Patient M N) —A node from the hypogastric area shows disappearance of normal fat and closed sinusoids. A large part of the node is replaced by radiation fibrosis. The tumor cells in the left center show no indication of radiation response.

sistence of disease, the right side of a planned bilateral retroperitoneal node dissection was undertaken. Direct evidence of radiation reaction was at once apparent in a moist, wet wound as the external oblique muscles were divided. The peritoneum stripped back with some difficulty, revealing obviously positive nodes occupying the obturator and hypogastric areas and extending up along the common iliac. The dissection was carried out with some difficulty due to the combination of actively involved nodes plus radiation reaction. The entire area was dissected clean, beginning up on the common iliac, extending down to denude both the external iliac and hypogastric vessels together with the hypogastric and obturator areas. All nodes were clinically positive.

The reports from the Pathological Laboratory were most illuminating and throw some light on the difficulties of properly administering deep x-ray therapy to such widely spaced nodal areas as the common iliac above the obturator area laterally and the parametrial area locally. The nodes removed from the common iliac area (Fig 378) show a complete replacement of the node by tumor without the slightest suggestion of radiation reaction. The normal fat is evident together with the open sinusoids. Neither the stroma nor the tumor has been touched by radiation. It thus is evident that the involved node lay beyond the scope of the radiation field. In this manner some of our cases may be lost. The nodes immediately adjacent in the hypogastric and in the obturator area show extensive radiation reaction with fibrosis, but tumor completely untouched growing with the node (Fig 379). This would seem to indicate that positive nodes within the radiated field had not responded to x-ray therapy.

Thus in this one case we may consider some of the reasons to doubt the effectiveness of x-ray therapy. First, the involved node may be out of the field and second, if it is in the field there is reason to question the effectiveness of x-ray as a cure. One may argue that the delay of three months permitted cancer to enter a previously radiated node though the pathologists feel that the closed sinusoids shown in Figure 379 precluded this possibility.

CASE II—The second case presented an unusual opportunity on checking the point of argument noted above. A large and fat Italian woman, P. E., aged 50, presented a Stage I lesion of the cervix confined to the endocervix of a freely movable uterus without clinical evidence of parametrial extension, so much so that a radical Wertheim operation seemed feasible. On completion of such magnitude were encountered along the external iliac, and continuing into the hypogastric vein, that further procedure abandoned after removing the positive nodes along the common iliac and marking the site of 7200 r units on the followed by 4500 mg. h.c. 100 mg. in a central apparatus. No local disease was apparent to vaginal smear and biopsy after six weeks, and at two months a retroperitoneal node dissection was performed on the side where previously proven positive nodes were to be found. The radiation reaction was extreme. The peritoneum stripped back with great difficulty exposing a firm, fibrous sheath investing the external iliac artery and vein as well as the common iliac and hypogastric. By sharp knife dissection on the vessels it was eventually possible to strip clean the entire hypogastric area which at the previous operation had been found to be involved. Dissection of the obturator area completed the operation.

Figure 380 would seem to indicate that despite the clinical and pathological evidence of extreme radiation reaction, indicated by complete replacement of the node by radiation fibrosis, tumor cells showing no sign of radiation response are still present. Perhaps this is what x ray is meant to do. It is possible that such a finding may



Fig 380 (Patient P. E.)—Two of three nodes in the same area at a previous attempt at Wertheim operation showed epidermoid Grade II. Following intensive radiation this node from the hypogastric area shows almost complete replacement of the normal node by the fibrosis of radiation. Isolated dark islands of tumor cells can be seen completely untouched by radiation.

explain the late metastases. Perhaps the operation was undertaken too soon, but it is also possible that despite the most intense clinical radiation response yet encountered in these dissections, active disease still lurks in the regional nodes.

COMMENT

No very definite conclusions can be made from these speculative observations. The present renewed enthusiasm for surgery in the treatment of cancer of the cervix appears to be based upon the known existence of the radiation resistant case doomed to failure from the start by the previously accepted forms of therapy, and upon the doubtful value of x ray therapy in the cure of regional nodes involved in disease.

The indications for the radical Wertheim procedure combined with a bilateral pelvic lymphadenectomy will doubtless be broadened in the

re to include the radiation resistant case as well as more advanced
stages of the disease

The place of the retroperitoneal node dissection in the future con-
sideration of the treatment of carcinoma of the cervix has not been finally
determined but would seem to be a logical approach in that it can be
applied to the majority of the cases encountered regardless of
size, age or general condition of the patient

Possibly in the future, in that group of cases regarded as unsuitable
for radical surgery, radiation therapy may be reserved for treatment
of the primary lesion, employing surgery rather than x ray for the
control of the regional nodes

SARCOMA BOTRYOIDES VAGINAE. COMPLETE EXCISION OF THE TUMOR IN AN INFANT BY THE COMBINED ABDOMINAL AND PERINEAL APPROACH

HOWARD ULFELDER, M.D.,* AND STUART H. QUAN, M.D.†

PRIMARY sarcoma of the vagina is rare, occurring approximately once in every 4,000 gynecological admissions.⁴ Although often discovered while still apparently a local growth, it is almost never cured. This discouraging prognosis is even more true of one variety in particular, the botryoid tumor of infancy and early childhood.

McFarland² in 1935 collected reports on 164 vaginal sarcomas. Of these seventy four were botryoides. All occurred before the age of 22, and forty two were in children 2 years of age or younger. Treatment when possible had been local surgical excision or radiation or both. No authentic cures could be confirmed by McFarland, although one patient showed no recurrence after one year, and another could not be traced. Isolated cases¹ have been reported since this classic review, all of them fatal.

These tumors arise just beneath the vaginal epithelium and form prolific, racemose, moist and friable growths which project into the vaginal lumen and eventually present at the vulva. Approximately 50 per cent begin on the anterior vaginal wall. Their progress is one of rapid local extension beneath the mucous membrane with eventual infiltration of adjacent viscera, particularly the bladder. Sepsis and urinary obstruction are the usual complications. Only three cases are reported to have shown distant metastases, one to the pleura, one to the lung, and one to a lymph node near the left renal hilus.¹

Experience with the radical hysterectomy in cancer of the cervix³ has demonstrated that complete removal of the uterus and upper vagina is anatomically feasible once the bladder and ureters have been freed and retracted out of harm's way. Better understanding of the blood supply of the lower urinary tract permits this extensive mobilization without fear of gangrene, and with an interruption of function that is seldom prolonged. Separation of the vagina from the rectum is never troublesome. What is more, the application of contemporary surgical knowledge in the use of anesthesia, parenteral fluids and bacteriostatic drugs has reduced the mortality of this category of radical surgery to levels comparable with those of major procedures in general.

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An almost insoluble problem in exposure confronts the surgeon who attempts wide local excision of a vaginal lesion in the infant even after a deep relaxing incision into the perineum. Limitations of space and interference with visibility from uncontrollable oozing combine to defeat him. By contrast, the major portion of the vagina is easily accessible from above, and the remainder from below. When one notes that sarcoma botryoides arises just beneath the mucosa and rarely metastasizes, the conclusion is inescapable that complete removal of the vaginal muscular tube by a combined abdominal and perineal approach must offer the best opportunity of cure.

Nancy A. aged 26 months was seen by Dr. Jesse S. Parker of Glens Falls, New York, with a history of recent urinary urgency and the protrusion of tissue



Fig. 381.—Drawing of reconstructed specimen immediately after removal.

from the vulva, first noted by her mother two weeks previously. No other symptoms were described. Examination under anesthesia disclosed a racemose tumor arising from the upper half of the posterior wall and filling the vagina. No palpable extension into other viscera was noted. Biopsy was reported sarcoma botryoides, and the patient was referred to Dr. Joe V. Meigs.

Examination on admission here showed a healthy female child with a red papillary tumor just visible at the vaginal orifice. Studies failed to reveal blood in either stools or urine. X-rays of the chest space and pelvis were negative. Vaginal smear showed many tumor cells indistinguishable from those seen in carcinoma of the cervix.

Intramuscular penicillin was started. Operation was performed by Dr. Joe V. Meigs twenty-four hours later.

Examination under anesthesia revealed a tumor arising high on the posterior vaginal wall. The abdomen was entered through a paramedian incision. The uterus was tiny and freely movable. The ovaries appeared normal. The peritoneum was opened on the anterior uterine surface and the bladder easily freed. Both tubes and ovaries were spared. The peritoneum was opened laterally and the ureters identified. The uterine arteries were ligated at their origin and the bladder and lower ureters then easily freed from the cervix and vagina. The bowel was separated from the vagina posteriorly and the vagina transected as low as possible. The pelvic peritoneum was reconstructed and the abdomen closed.

With the patient in lithotomy position it was then determined that about three-quarter inch of vagina remained. The perineum was incised for exposure and all remaining posterior and lateral vagina easily resected. Only that portion under the urethra was spared. A small pack was placed in the perineal wound and a catheter sewed into the urethra. Two hundred and fifty cc. of citrated whole blood were given intravenously during the course of the operation. Recon-



Fig 382—The epithelial covering is shown ($\times 110$)

struction of the specimen showed the uterus and major portion of the vagina present in all layers. A wide margin of normal tissue surrounded the tumor (Fig 381).

The patient's postoperative course was uneventful. The catheter fell out on

... being done every other day and residual urine varied from

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m
The

upper half of the vaginal segment has been dilated by the tumor mass and measures 2.5 cm in circumference. The lower half uninvolved vagina measures

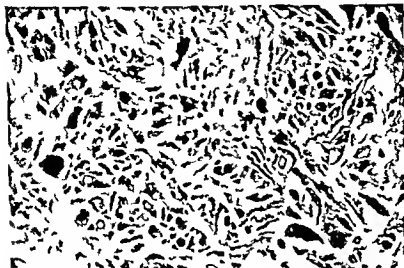


Fig 383 High power photomicrograph of tumor stained with Mallory's phosphotungstic acid and hematoxylin to show the large cells with granular and fibilla cytoplasm which suggest imperfect muscle striations ($\times 500$)



Fig 384 -The myxomatous area is shown ($\times 110$)

1.3 cm in circumference. Arising in the vaginal wall 0.4 cm from the cervix is an elevated greyish white tumor mass with a granular surface covered with soft tiny 1 to 9 mm nodules. The tumor measures 2 cm in circumference.

covers all but 7 mm of the vaginal circumference, and measures 1.5 cm in length. In two areas there are soft, gray-pink bleblike structures measuring 9 mm and 0.4 mm in diameter attached by a thin stalk. The tumor does not appear to infiltrate the vaginal wall and underlying fascia.

Microscopic (sections stained with hematoxylin-eosin and Mallory's phosphotungstic acid hematoxylin) —The polypoid tumor excrescences are covered with layers of closely packed stratified squamous cell epithelium which resemble normal vaginal mucosa (Fig. 382).

The bulk of the more solid portions of the tumor is made up of small spindle shaped cells with pale basophilic oval nuclei and indistinct cell walls. The faintly



Fig. 385 —Upper half of tumor to show origin in vagina below level of cervix and lack of invasion. A, Endocervix; B, cervix; C, tumor ($\times 85$).

acidophilic cytoplasm seems to end in strands which blend with those of other

strations (Fig. 383).

Sections through the more translucent polyps show myxomatous areas char-

CONCLUSIONS

- 1 *Sarcoma botryoides vaginae* of children arises just beneath the vaginal mucosa and rarely metastasizes
- 2 Treatment in the past by wide local excision or radiation, or a combination of the two, has seldom effected a cure
- 3 Complete removal of the uterus and vaginal muscular tube is feasible by a combined abdominal and perineal approach
- 4 The only example of this lesion ever seen in the Massachusetts General Hospital is reported to illustrate this contention

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RUPTURED CERVICAL DISKS

A Summary of Twenty-four Verified Cases

JOST J. MICHELSEN, M.D., F.A.C.S.*

In 1928 Stookey published a paper on the subject of cord compression due to "ventral extradural cervical chondromas." He described seven cases with three different syndromes: that of bilateral ventral pressure (three patients), that of unilateral pressure (three patients) and that of nerve root pressure (one patient). He reviewed the subject thirteen years later at which time the underlying pathologic condition was more properly designated as protrusion of the nucleus pulposus through the annulus fibrosus into the spinal canal. Mixter and Ayer and others reported their experiences with cervical cord compression by ruptured disks. Semmes and Murphey, Spurling and Scoville, Michelsen and Mixter and others contributed to our knowledge of the clinical picture of root compression, heretofore considered rare.

In this study the number of patients with manifestations of root compression without cord involvement was considerably greater (20) than that with encroachment upon the cord itself (4). Most frequently the disk ruptures occurred at the interspace between the sixth and seventh, less often between the fifth and sixth, and only in one instance between the seventh cervical and first thoracic vertebrae.

during the illness—not necessarily on admission to the hospital—was pain in the lower portion of the neck, shoulder region, arm and hand. The discomfort was aggravated by movements of the neck. Furthermore, there was great similarity of the segmental pattern of the symptoms presented by patients with root compression only and certain sensory and motor manifestations in those with signs of cord compression. These common features can be accounted for by the nature of the underlying pathology: a discrete comparatively small mass originating from the intervertebral disk projecting in a circumscribed area into the ventral aspect of the vertebral canal and probably changing in size and position with movements of the cervical spine.

Segmental sensory disturbances included pain ("stabbing," "shoot ing," "sharp," "acute") and paresthesias ("numbness," "deadness," "heaviness," "tingling," "pins and needles," "electric shocks") dyse-

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thesias and hypesthesia. An approximate outline of the segmental sensory supply to the upper limb is given in Figure 386. These two

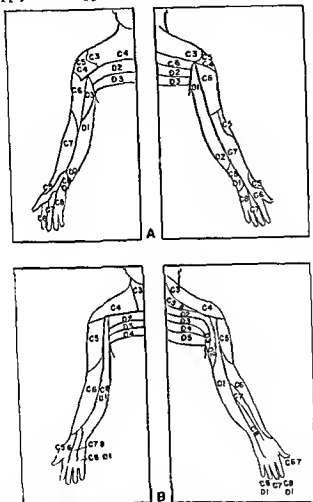


Fig. 386—Distribution of cervical dermatomes. A According to Foerster. B According to Pauchet & Dupret (New England J Med. Vol. 231, 1944).

diagrams are more—although not entirely—consistent with the distribution of the sensory abnormalities observed than other charts.

Segmental motor changes included weakness, wasting, hypotonia, fasciculations, diminution or absence of arm reflexes and electromyographic disturbances of the affected muscles. According to Foerster

the segmental innervation of the more important muscles of the upper extremity which can be readily examined is as follows

Supraspinatus	C4	C5
Deltoid	C5	C6
Biceps	C5	C6
Extensor carpi radialis	C6	C7
Flexor carpi radialis	C6	C7
Triceps	C7	C8 Th 1
Abductor pollicis brevis	C7	C8
Abductor digiti quinti	C8	Th 1
Interossei	C8	Th 1

Biceps and radial reflex are represented in the fifth and sixth, the triceps reflex in the seventh, eighth cervical and first thoracic segments

UNILATERAL DISK PROTRUSIONS, PRODUCING "BRACHIAL NEURALGIA"

The syndrome produced by lateral protrusions of cervical disks (Fig 387, a) seems now well established. The chief complaint in our cases was pain in the region of the scapula, arm and hand, present

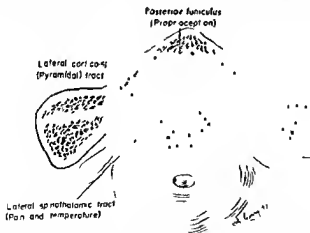


Fig 387—Diagram to show the relationship of cervical disk herniations to nerve roots and spinal cord. *a*, Herniation with root compression. *b*, Herniation with unilateral cord compression. *c*, Herniation with bilateral cord compression.

either from the start or beginning in the shoulder blade, the distal part of the extremity pain most patients experienced a dull gnawing ache, more or less constant in certain muscles of the arm. Paresthesias involved the fingers chiefly. Coughing, sneezing, straining and, in almost all cases, neck move

ments, particularly hyperextension and tilting the head toward the side of the lesion, aggravated the sensory manifestations

Typical changes found on examination included tenderness of the shoulder blade, suprascapular area and lower cervical spine. Not infrequently there was a "trigger" point on the scapula from which pain and paresthesias in the affected extremity could be elicited by deep palpation. "Objective" sensory and motor abnormalities involved the respective dermatomes and muscles, including reflex changes in accordance with the level of the lesion.

At the interspace below the fifth cervical vertebra (sixth cervical nerve root) sensory manifestations were present in the upper arm (anterolateral) antecubital region, radial forearm, thumb, thumb and index finger, or the fingers were spared, at that below the sixth cervical vertebra (seventh cervical nerve root) in the upper arm (posterolateral)

with a protrusion between the seventh cervical and first thoracic vertebrae (eighth cervical nerve root) had pain and paresthesias in the upper arm (inner aspect), forearm and little finger. Lewis observed sensory manifestations on the upper arm (anterolateral and adjacent to the axilla) and at the base of the thumb in a patient with compression of the fifth cervical root.

As to the motor changes at different levels valuable information was obtained from electromyographic studies in cases with compression of the seventh cervical root. Spontaneous discharges were observed most often from the triceps muscle, also from the deltoid, extensor carpi ulnaris, extensor carpi radialis, flexor carpi radialis and opponens pollicis muscles. On clinical analysis weakness was observed in the biceps and deltoid with compression of the sixth, deltoid, biceps and triceps with involvement of the seventh, triceps, adductor of the thumb, flexor of the little finger and interossei muscles with implication of the eighth anterior roots, respectively.

Plain x ray films, as a rule, showed absence of the normal cervical lordosis in the lower cervical spine. Narrowing of the sixth interspace if present, was invariably significant.

Cerebrospinal fluid dynamics were normal. The total protein of the fluid varied. Its value was found . . .

Routine myelography . . . diagnostic arthrography . . . filling defects or arrest of the radiopaque substance (injected and removed by the lumbar route) were seen at the site of the ruptured disk.

The indication for operation was based upon the degree and duration of the patient's disability. Almost all patients had a trial with neck

traction and other forms of conservative treatment either prior to their hospital admission or after completion of the diagnostic study. In some cases not included in this study a satisfactory result of neck traction made surgical intervention unnecessary.

The operation consisted of a subtotal hemilaminectomy, more recently with the patient in upright position. The disk fragment was removed extradurally or transdurally if the extradural approach was deemed inadvisable.

The operative results were gratifying. There were no fatalities or major complications. Two patients developed a recurrence and were re-explored. One of them, following the second operation, showed a mild Brown Séquard syndrome which gradually cleared up except for some disagreeable paresthesias in one leg. This same patient later developed arachnoiditis in the cervical region. Another patient failed to regain normal sensation in the dermatome corresponding with the compressed root (C_7) after removal of the disk fragment.

With regard to case reports, I refer to the paper published in 1944. *Limitation of space does not permit, and the consistency of the more recent observations with the outline given previously hardly requires additional details.* The differential diagnosis of spinal root compression by ruptured disks versus "brachial neuralgia" due to other causes was also discussed previously. The question of cervical root compression by arthritic spurs deserves further studies.

MEDIALLY PLACED DISK PROTRUSIONS, PRODUCING COMPRESSION OF THE CERVICAL CORD

The manifestations in this group are essentially those of a mass lesion lying ventral to the spinal cord. Their interpretation is not difficult, if the gross anatomy and physiology of the spinal cord and the relation of the lesion to the various structures are kept in mind (Fig 2). If the disk rupture has occurred paramedially (Fig 2 b) pressure is exerted upon one half of the spinal cord with homolateral pyramidal signs, contralateral pain and temperature disturbances and homolateral changes of discrimination (Brown Sequard syndrome). If the whole cord is displaced by a midline lesion (Fig 2 c) bilateral motor and sensory alterations are found. Two cases may be cited in illustration of these conditions.

CASE I—A 47 year old heavy laborer (M. G. H. No. 562151) was admitted to the hospital because of right shoulder pain and weakness of the right side of

a wheel chair existence at home He was referred with the diagnosis of "subdeltoid bursitis and paralysis of right side"

Findings on admission included (1) Tenderness to deep palpation over the fifth and sixth cervical spinous processes with radiation of pain down both arms more on the right (2) Right Horner's syndrome (3) Weakness of entire right side from the shoulder down (4) Diminished right biceps reflex exaggerated right knee and ankle jerk absence of right cremasteric and abdominal reflexes right Babinski and Hoffman (5) Diminution of pain temperature and light touch sensation over the left side of the body up to the clavicle and including the ulnar aspect of the arm to the finger tips slight impairment of position sense in right hand hypesthesia on lateral side of right arm (6) Cerebrospinal fluid examination total protein 121 mg per 100 cc, normal dynamics (7) Myelogram Large space consuming lesion midline extending over to the left causing almost complete obstruction of the left gutter from the fourth to the sixth cervical vertebra and also producing a pressure defect on the right at the fifth cervical vertebra

Operation revealed a ruptured disk fragment at the fifth cervical interspace to the right of the midline which was taken out transdurally

The postoperative course was smooth The patient was very much improved at the time of his discharge

CASE II—Another very instructive case was that of a 49 year old housewife (M G If No 403409) who on admission complained of weakness of both arms and legs Three months prior to admission she noticed a dull ache in the left arm and some weeks later severe discomfort at the base of the neck left shoulder blade also shooting pain and paresthesias in the left arm and fingers aggravated by coughing sneezing and movements of the neck She was treated for neuritis Six days before admission the left leg suddenly became weak the weakness rapidly spread to the left arm right leg and right arm the urinary bladder became paralyzed

Neurological findings on admission included (1) Tenderness of lower cervical spine (2) Almost complete paralysis of left leg marked weakness of right leg and both arms (3) Bilateral pyramidal tract signs triceps reflexes absent (4) Diminution of sensation for all qualities over the whole body with an upper level in the ulnar aspect of the forearms (5) Urinary retention (6) Cerebrospinal fluid examination total protein 204 mg per 100 cc normal dynamics

It was removed transdurally

The postoperative course was gratifying The patient now—seven months after operation—has normal bladder function normal sensation almost normal motor power in her legs marked improvement of the strength of the extensors of both arms triceps reflexes are present but she still has intermittent sharp pain in both arms on awakening in the morning

The characteristic clinical signs of cord compression in these two and other patients observed including the very dramatic Case V in the series reported previously do not require any additional comment However certain features which are rarely seen in the average case of compression of the cervical cord and have been overlooked in the past will be considered briefly They might help to establish a specific syndrome of cord compression by ruptured cervical disks They

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RELIEF OF PAIN BY OPERATIONS ON THE CENTRAL NERVOUS SYSTEM

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OPERATIONS on the central neuraxis for relief of severe pain are coming into progressively more extensive use pari passu with our increasing knowledge of the loci at which surgical interruption of nerve fibers precludes conscious appreciation of pain or concern about it in different parts of the body.

Thoracic Cordotomy—The oldest of the operations, anterolateral cordotomy or tractotomy first carried out by Martin at Spiller's suggestion has now become a standard procedure in most neurosurgical clinics and division of the fibers in the anterolateral portion of the spinal cord at the second or third thoracic segment can be counted upon almost certainly to provide relief of pain referred to any part of the body below the costal margin on the side opposite the incision into the cord. Happily it makes no difference whether the pain is referred to superficial areas or to deeper abdominal or pelvic viscera or whether the pain is transmitted over fibers traveling with the visceral or the somatic nerves. All the pain fibers whatever their provenance appear to gather in the anterolateral area of the cord on the side opposite the origin of the pathway. Thus for the relief of pain below the middle of the trunk we are in an excellent position. Unilateral division of the pain fibers causes commonly no untoward sequel except a transitory disturbance of urinary function. Bilateral division at one stage on the other hand may cause permanent impairment in the control of bladder and bowels and even weakness in the lower limbs. These undesired features are more likely to be avoided if the operation is carried out in two stages a week or more apart to permit subsidence in the edema of the spinal cord on one side before the tract on the other side is cut. The second incision is made two or three spinal segments distant from the point of the initial incision.

Only in cases of pain referred to phantom limbs following amputation has the sovereignty of the remedy of cordotomy been seriously questioned. Bailey and Moersch¹ have reported many cases in which the operation failed to relieve pain in the special situation in which the pain was referred to a phantom limb. At this hospital however we are more sanguine about the likelihood of stopping phantom pain by cordotomy. Dr J. C. White¹⁴ has reported three cases in which such

virtually eliminated by section of the spinothalamic tracts. We have had only one case in which the phantom pain was unrelieved following operation. In six of our seven cases the pain was referred to a phantom lower limb. In the seventh case pain in a phantom hand and its fingers following amputation near the shoulder joint has been relieved by section of the spinothalamic tract in the medulla oblongata. One of my cases had pain referred both to an amputation stump and the phantom extending beyond and is of particular interest in suggesting an explanation of at least a few of the failures of cordotomy.

CASE I—M. D., a male patient 40 years old, had had for two years pain in an amputation stump at the upper thigh which extended down into the remainder of his phantom thigh. A cordotomy elsewhere in October 1944 had relieved his pain for only a few days. When he entered the Massachusetts General Hospital for the first time on August 17, 1945, he showed analgesia over almost all of his right side below the umbilicus. Over a few inches along the medial aspect of his amputation stump there was marked hypalgesia, but an occasional pin prick was

thoracic dermatome, the patient insisted that his spontaneous pain was worse. Upper thoracic anterolateral cordotomy was nevertheless carried out on September 7, 1945. An analgesia throughout the right side below the fifth intercostal space was produced. The patient was relieved at once of all of his original pain and had maintained this relief when last heard from sixteen months later.

The fact that this patient complained of pain in an area not quite analgesic to pin prick gave us our clue to the reason for failure of the first cordotomy. But in patients in whom pain is referred only to the phantom limb there is no method of postoperative testing which enables the surgeon to be so certain.

CONCLUSION

It was hoped that spinal anesthesia would serve as a reliable diagnostic test under these circumstances to indicate whether or not the cordotomy was complete. If the phantom pain stopped when the level of spinal analgesia included all areas below the middle of the trunk, one would infer that an incomplete cordotomy had been done; but if the phantom pain continued or worsened, as in the above case, one might have inferred that the cordotomy was complete and that the pain was due to a fixation at the intracranial level of a response pattern involving pain (Riddoch⁷, Lenke⁸). In my case the persisting relief of pain after the second cordotomy demonstrates that failure of spinal

anesthesia to relieve the pain is not a result from which one may infer adequacy of a previous cordotomy. We remain without a reliable method of determining objectively whether or not all of the fibers from the phantom have been divided, unless extensive infiltration with procaine of all nerves to the stump proves to be a valid test.

Cervical Cordotomy.—High cervical cordotomy for relief of pain in the contralateral upper limb and chest has a much more limited application, and the higher the dermatome on the upper limb involved in the pain, the less likely is it that the surgeon will be able to secure the necessary analgesia. This case, however, indicates a common type in which this procedure is valuable.

CASE II—S. B., an 81 year old man, following an attack of herpes zoster in November 1913 had had pain the third to the sixth dorsal or posterior aspect of the chest as worsened by even the lightest his waking hours. The pain was improved for a few days by a procaine injection in the region of the fourth right intercostal neurovascular bundle. Several intercostal nerves were blocked producing analgesia for a five inch band around the left chest and relieving all pain temporarily. X ray therapy gave no relief, and ultraviolet and infra red therapy aggravated the pain. On September 13, 1945 he was given a spinal anesthesia with 100 mg of procaine. This gave an analgesia to pin prick everywhere below the first thoracic segment and relieved all of the pain. Discomfort returned gradually but had not attained its original severity until mid October 1945. The procaine spinal anesthesia was repeated on October 26, 1945, but gave inadequate relief of the pain. It became gradually worse and on January 11, 1946, right cervical anterolateral cordotomy was performed in the lower part of the second cervical segment. As an essential part of the procedure the patient was awakened on the operating table and analgesia over the left torso and left upper limb was demonstrated. Postoperatively he maintained

of pain

The pains of herpes zoster may be due to persistence of lesions in the posterior root ganglia, to lesions of sensory nuclei in the central nervous system, or to both causes. In this case the relief of pain for several weeks by spinal anesthesia provided evidence that no lesion higher than the posterior horn cells connected with the involved dermatomes was producing pain. In earlier years at this hospital the section of three or four posterior roots was tried in such cases, but the results were disappointing. This suggests that in the majority of post herpetic neuralgias there is a lesion in the nuclei of brain or cord concerned with transmission of the sense of pain as well as such lesion in the posterior root ganglia. If we could count on obtaining the high level of analgesia secured in the case reported here upper cervical cordotomy would enjoy a more extensive use.

Bulbar Spinothalamic Tractotomy.—For relief of pain in the neck and upper limb Schwartz⁸ and White¹³ have introduced section of the spinothalamic tract in the medulla oblongata. I have used this procedure successfully to provide relief of pain in a phantom hand, the case referred to earlier in this paper.

In the medulla oblongata the topographical disposition of the spinothalamic fibers connected with the arm and neck is distinctly unfavorable since they lie in the deepest part of the area traversed by the whole tract. The production of analgesia up to the level of the mid cervical segments requires an incision 6 mm deep. In my experience if an incision at this depth is extended dorsoventrally until the patient is analgesic in the desired area as tested on the operating table, the procedure is poorly tolerated by the patient already grossly debilitated from a malignant neoplasm. Of the four patients with such advanced cancer upon whom I have done this operation only two have not died early in their postoperative course from disturbances probably attributable to the medullary trauma. The two cases surviving operation did not have adequate relief from their pain.

Mesencephalic Spinothalamic Tractotomy.—For such cases as the above we are now giving the mesencephalic spinothalamic tractotomy of Walker¹⁰ a trial. At the level of the midbrain the tract although requiring an incision 5 mm deep is not so close to vital areas. Complete analgesia to pin prick over the desired area was not maintained in three of four cases reported by Walker but two of the three cases with hypalgesic zones and the one with analgesia had satisfactory degree of relief of pain.

My single experience with this operation an encouraging one follows.

CASE III—P. M., 11 Jan. of 81 years, had extensive epidermoid carcinoma in the left side of his neck and at the angle of the mandible metastatic from a lesion in the left upper lip which had recurred following local excision in May 1945. Forty-two hundred r of x-ray therapy had been given during September 1946 but had not relieved adequately the severe pain extending from the vertex of the scalp down to the clavicle anteriorly and the scapulae posteriorly. X-rays of the chest suggested extensive metastatic disease in both lung fields but there was no pain in the chest. A right mesencephalic tractotomy under local and pentothal anesthesia on December 24, 1946 produced a marked hypalgesia over the left face and neck with a less pronounced but still marked hypalgesia over the left upper limb and chest which gradually diminished over the abdomen. There was minimal if any hypalgesia in the left lower limb. Visual fields showed a left homonymous defect whereas they had been normal preoperatively; the face and limbs moved normally. The original pain was completely relieved from the time of operation until the patient's death three weeks later with cyanosis and dyspnea. Postmortem examination in Dr. Tracy Mallory's department revealed that the immediate cause of death was probably in the lungs. Both were filled with white firm nodules of carcinoma up to 2.5 cm in diameter between which were many areas of bronchopneumonic consolidation and the two pleural cavities

contained a total of 2500 cc. of clear, amber-colored fluid. I am indebted to Dr. Charles Kubik for the photograph of the lesion made in the mesencephalon (Fig. 388).

The hyperpathia and disagreeable paresthesias which are sometimes a late sequel of this operation had not appeared by the time of death in this case.

Bulbar Trigeminal Tractotomy.—The earliest demonstration that an incision into the brain stem can have useful therapeutic results was provided by Sjöqvist² who first described the operation for section of

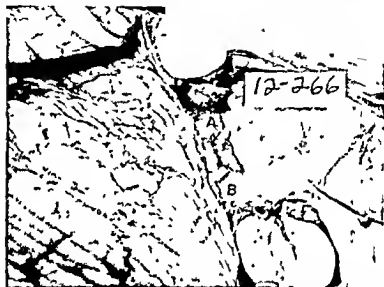


Fig. 388.—Cross specimen three weeks following mesencephalic tractotomy. Much of the cerebrum has been cut away to expose the side of the midbrain. Letter A lies on colliculus, letter B lies on cerebral peduncle. The incision into the brachium of the inferior colliculus lies between the letters A and B and its dorsal and ventral limits are indicated by small arrows.

small percentage of the patients subjected to section of the posterior root of the fifth cranial nerve. In my experience of twenty-seven bulbar trigeminal tractotomies this hope has not been borne out. In seventeen of my cases the operation was carried out for the relief of pain not due to neoplasm. In two of these cases, 12 per cent, a disagreeable constant

paresthesia in the skin of the face has constituted a major source of dissatisfaction to them, and in two others similar paresthesias have been intermittently annoying

However, the performance of the operation has revealed other advantages¹⁰

1 Although the cornea (and the entire ophthalmic division of the trigeminal nerve) can be deprived of painful sensation, the cornea preserves a touch sensation which is adequate to protect it from damage arising from foreign material in the eye. After section of the posterior root fibers from the cornea, both touch and pain sensations are lost and the cornea may become ulcerated and opaque. Hence, in any case with pain arising in the first division of the trigeminal nerve, in which one would have to deprive the cornea of all sensation in order to relieve the pain by posterior root section, I prefer bulbar tractotomy. In all of my cases the patients have had no corneal lesions despite the fact that they have worn no protective eye shields.

2 In patients who do not have useful vision in one eye and develop trigeminal neuralgia on the other side, I do bulbar tractotomy, again to minimize the possibility of damage to the remaining good eye.

3 In patients in whom the motor fibers to the masticator muscles are not functioning on one side and in whom trigeminal neuralgia develops on the other side, bulbar tractotomy is done because the motor root cannot be damaged during this operation, whereas it is frequently cut during a trigeminal posterior root section. Although a unilateral paralysis of the masticator muscles is scarcely noticed by the patient, a bilateral paralysis of them is a severely incapacitating lesion.

4 In patients in whom the possibility of an organic lesion in the posterior cranial fossa as a cause for the pain is hard to exclude preoperatively, I prefer tractotomy to section of the posterior root of the fifth nerve at the extreme anterior end of the posterior fossa.

In the seventeen cases done for relief of pain not due to neoplasm there was no mortality and the original pain was entirely relieved in sixteen cases.

cases in which bulbar trigeminal tractotomy combined with upper posterior cervical rhizotomy was used in cases having neoplasms in the oropharyngeal area, face and neck, there was an operative mortality in four cases, 40 per cent, and only one of the cases leaving the hospital alive after operation has maintained satisfactory relief of pain despite the fact that analgesia to pin prick was obtained. Hence we are searching for some better method of handling these cases.

Bilateral Prefrontal Lobotomy.—There is a possibility that bilateral prefrontal lobotomy (leukotomy) may be the answer to the problems stated above. Freeman and Watts³ have found that in patients

with pain due to malignant neoplasm, the affective or disagreeable component of the pain is likely to disappear following this operation, in which most of the white fibers connecting the prefrontal lobes with the remainder of the brain are severed. Even though when asked about it the patient may still state that he has pain, he no longer minds it and does not wish analgesic medication. In a limited experience at this hospital we have found that if the patient lives long enough he may begin again in months or years to complain of his pain. Hence we are at present restricting the use of this operation to cases with a short life expectancy.

CASE IV—J. J. C. a young man of 28 years had pain in and about the right orbit which began in May 1945. During the next month poor vision and proptosis on the right and diplopia appeared, and by mid July 1945 there were ophthalmoplegia and blindness on the right. Operative attack on a tumor in the right middle and anterior cranial fossas and in the right orbit was carried out in July 1945 and again for recurrence in November of that year while the patient was still in the Army. A diagnosis of meningeal sarcoma had been made. In December 1945 bulbar trigeminal tractotomy and glossopharyngeal neurectomy had been carried out in an attempt to relieve pain in the face and "deep in the ear." The pain in the face persisted and the patient had a course of x-ray therapy without relief. The proptosis had become more severe and in October 1946 the right eyeball had been removed. A biopsy at this time was diagnosed by Dr. B. Castleman as osteogenic sarcoma. In preparation for a "do or die" attempt at removal of the tumor the right internal and later the right external carotid arteries had been ligated.

The patient first entered the Massachusetts General Hospital the day after the last named procedure on November 19, 1946. However examination now

pain in his face. The bulbar tractotomy had not been done by the authors technique and had not produced analgesia to pin prick throughout any of the three trigeminal divisions.

tively it had risen to 90 when repeated on the eighth postoperative week. He died at home on February 7, 1947, after one week of coma. His wife was satisfied that he had been relieved of worry over his tumor and his pain.

Partial Postcentral Gyrectomy.—One further type of operation remains to be mentioned. It has been suggested by Riddoch⁷ and Leriche⁸ independently that the phenomena of a phantom limb, including the pain referred to it, might be stopped by removal of the corresponding portion of the postcentral cerebral gyrus. De Gutierrez Mahoney⁴ has achieved an unqualified success in the first case in which he carried out this procedure, but in a recent personal communication he states, "I have done only four patients and I am on the point of reviewing the results. It is now my impression that the procedure is not the answer for the treatment of painful phantoms. There is obviously a much wider cortical sensory representation than the postcentral area. The success in my cases had not been adequately long lived to recommend it other than as a method of study." Horrax⁵ has reported results which are discouraging in four cases of pain in the limbs due to diverse causes.

J. T. B. Carmody and I⁶ are recording an interesting experience in another case: a man who despite a variety of measures over several years, was incapacitated by pain referred to his phantom right thumb, index and middle fingers. We removed the postcentral gyrus over an area which included the representation of these three fingers after careful studies of the exposed cerebral cortex which included procainization as well as electrical stimulation. The patient has remained practically free of his pain for the fourteen months which have elapsed since operation. Determination of the value of the procedure must await reports of more cases.

SUMMARY

The operations for relief of intractable pain of thoracic, cervical, bulbar and mesencephalic tractotomy, bulbar trigeminal tractotomy, bilateral frontal lobotomy and partial postcentral gyrectomy have been discussed in terms of indications for the procedures and probable results thereof.

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The patient first entered the Massachusetts General Hospital the day after the last named procedure on November 19, 1946. However, examination now disclosed a massive firm swelling in the soft palate and nasopharynx as well as

and had not produced analgesia to pin prick throughout any of the three trigeminal divisions.

PROCAINE BLOCK OF THE SYMPATHETIC NERVES IN THE STUDY OF INTRACTABLE PAIN AND CIRCULATORY DISORDERS

JAMES C WHITE MD FACS *

ALTHOUGH the use of drugs to produce insensibility to pain was discovered a hundred years ago a very important by product their use in the selective block of the somatic and visceral nerves has been developed in the past thirty years This method of investigation has been particularly useful in advancing anatomical knowledge of viscerosensory and sympathetic motor innervation and in the practical application of this to the surgical treatment of intractable pain and peripheral vascular disease

Blocking the viscerosensory axones by paravertebral injection of procaine hydrochloride was first proposed by Kappis¹ and greatly advanced by the pioneer work of Lawen² von Giza³ Mandl⁴ and Leriche⁵ The method was first used in this hospital by me early in 1927 in the investigation of pain transmission in angina pectoris Later while working at Professor Leriche's clinic in Strasbourg I was further impressed by its value and on returning here in 1928 lost no time in putting it to wider use In the intervening years Dr R H Smithwick and I have blocked the visceral nerves with procaine extensively This has enabled us to develop a number of operative measures for the relief of hitherto intractable forms of visceral pain In addition its adaptation for measuring the degree of vasoconstrictor tone in peripheral vascular disease was first proposed and developed here⁶ It is the purpose of this paper to give an historical account of the development of these diagnostic methods and a summary of the clinical advances that have been made through their use by the surgical services of this hospital

From the Massachusetts General Hospital, Surgical and Neurosurgical Services and the Harvard Medical School Surgical Laboratories Boston This paper was presented at the Annual Meeting of the American Association of Surgeons, Boston, June 1934

* Chief of
Surgical Service

† In performing any paravertebral injection care must be exercised not to

This is no place for more than a brief comment on the technic, safeguards of injection, methods which have been described elsewhere in detail^{10 11 12 13} and which we have largely adapted from excellent monograph of Labat¹⁴ For increasing the accuracy of in

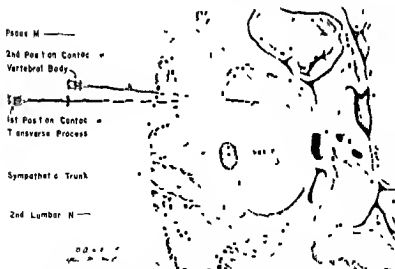
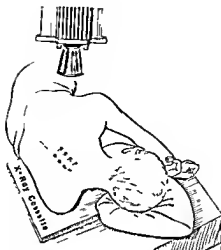


Fig 390 -Technic of insertion of needles for injection of lumbar sympathetic ganglia

tion when permanent block is attempted with alcohol, Gentry and have found that visualization of the position of the needles by x ray a very helpful procedure The placement of the needles for infiltra-



2nd Position, Contact with
Vertebral Body

1st Position, Contact with
Transverse Process

2nd Intercostal Nerve, _____
Sympathetic Rami & Trunk

2nd Rib _____

*U. S. Hallmark
after Dr. McPhee*



Fig 389—Technic of insertion of needles under x ray control for injection of upper thoracic sympathetic ganglia

TABLE I

CASES OF INTRACTABLE CARDIO-AORTIC PAIN RELIEVED BY PARAVENTRAL BLOCK AND SYMPATHOTOMY

Condition	Number of Cases	Paravertebral Block	Operation	Result
Angina pectoris	75*	Procaine and alcohol T ₁ -T ₄		Excellent, 56%; fair, 21 3%; failure, 8%; unclassified 6 7%; death, 8%
	8		Thoracic ganglionectomy T ₁ -T ₄ (by Drs Mixer, Allen and White)	Excellent in all but a partial recurrence after a year in 1, and 1 operative death at 1 mo
Aneurysm of aortic arch	2	Procaine and alcohol T ₁ -T ₄		Excellent to death at 3 mos and 5 1/2 yrs
	1	Procaine alone		Excellent for last 6 weeks of life

* Five of these injections were performed by Dr W J Mixer

By using larger quantities (5 to 10 cc) of 1 per cent procaine injected against the sides of every second vertebra, a very wide temporary denervation can be obtained. Kappis's¹ method of infiltrating the splanchnic nerves beneath the diaphragm, recently improved by de Souza Pereira,¹² produces a block of the entire splanchnic bed and all the upper abdominal viscera. If, as de Souza Pereira has stated "it is possible before operation to determine what result may be obtained this type of operation [sympathectomy] can attain a high degree of accuracy." By infiltrating the chain of sympathetic ganglia with procaine at different levels along the vertebral column, it has been possible to map the segments¹³ of the viscera with temporary diagnosis. In this way, a demonstration of what can be accomplished by the proposed operation.

PARAVERTEBRAL PROCAINE BLOCK IN THE STUDY OF VISCERAL PAIN

In certain forms of visceral disease characterized by intractable pain the fundamental condition often cannot be corrected by standard medical or surgical measures. Yet even under such circumstances much may be accomplished by an indirect neurosurgical attack on the afferent nerves which transmit painful impulses from the diseased organ. Examples of the conditions in which paravertebral block has been most helpful are severe angina pectoris, painful aneurysms of the aorta, cancer of the upper abdominal viscera, penetrating duodenal ulcer (in patients with advanced coronary disease), postoperative narrowing of the biliary ducts and pancreatic calculus. I shall point out briefly what we have learned at this hospital about viscerosensory innervation in these conditions by means of selective nerve block.

Angina Pectoris—Following the prediction of François Franck¹⁴ that medically intractable angina pectoris could be relieved by sympathectomy, Jonnesco¹⁵ in 1916 reported the first successful results. In his first patient the operation was performed by European and American surgeons. In the large number of cases reported by European and American surgeons in the last decade only slightly over 60 per cent of the cases have been relieved.

It became obvious that the cause of surgical failure was incomplete anatomical knowledge of the pathways of pain from the heart.

In that year, during the course of an operation for angina pectoris under local anesthesia, Lenche²¹ made a most important observation. Direct injection of the exposed stellate ganglion with procaine resulted

ticularly true when the aneurysm is situated in the aortic arch and is expanding upward into the outlet of the thorax. It would be logical to suppose that under these circumstances the pain is caused by pres-

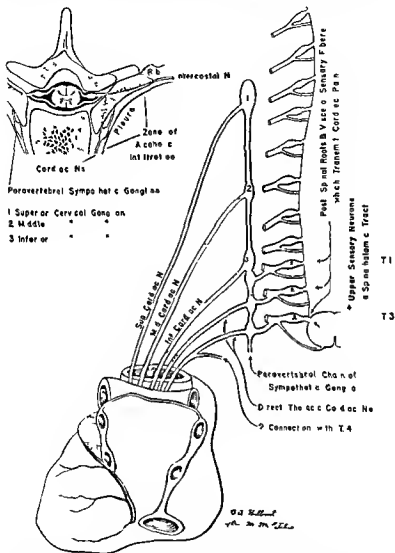


Fig. 391—Anatomical diagram of the cardiac afferent fibers from the heart

sure on the parietal pleura and the intercostal nerves. In order to test the pathway of pain sensation White²³ performed diagnostic procaine block in three patients with large and intensely painful aneur-

in immediate relief of an attack of severe cardiac pain which developed on the operating table.⁶ In the same year the publication of Mandl's⁷ experience with paravertebral injection of procaine first suggested the presence of upper thoracic cardiac rami in addition to the classical cervical cardiac nerves. These delicate thoracic rami which run from the upper three or four thoracic sympathetic ganglia to the

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rey and Atkins⁸ and by subsequent clinical experience. It is now generally recognized that they constitute an important accessory pathway for the conduction of pain from the heart.

Soon after

alcohol to

Chemical

seventy-five cases at this hospital. Results in this group are summarized in Table 1. At first we routinely used diagnostic injection with procaine before attempting a permanent block with alcohol. Today after twenty years' experience we are so sure that all the

sensory

thoracic

that a p

anginal pain is referred to unusual areas. Furthermore during this twenty-year experience Dr. E. M. Bland and I²² have been convinced that in all but the poorest risk cases direct surgical intervention should be used either by resection of the upper three thoracic sympathetic ganglia or by posterior rhizotomy. Today paravertebral alcohol injection is reserved only for the poorest risk cases. It fails to give effective block of cardiac pain in some 8 per cent of cases and is followed by troublesome intercostal neuralgia in 10 per cent. Recurrence secondary to nerve regeneration has been relatively rare (18 per cent) and usually mild. On the other hand resection of the upper three or four thoracic sympathetic ganglia or cutting the corresponding posterior spinal roots is nearly certain to give permanent relief. Although the injection method for control of the most severe cases of angina pectoris has been largely superseded we have nevertheless learned a great deal from our extensive early experience.

Intractable Pain in Aneurysms of the Thoracic Aorta.—Most aortic aneurysms are not acutely painful but cause symptoms only through pressure on neighboring structures. At times however they may produce intense suffering. In our experience this has been par-

⁶ Lenche attributed this clearest interruption of pain to paralysis of the coronary vasoconstrictor fibers rather than to interruption of the sensory pathway. Modern evidence however favors the latter theory.²²

an aneurysm in the lowest portion of the descending arch of the aorta by injecting the second to sixth thoracic sympathetic ganglia. Eleven months after injection this patient remained free of pain and had returned to active work. Another successful case has been reported by Rasmussen and Farr.²⁰

Intractable Pain in Disease of the Upper Abdominal Viscera.—Chronic disease of the upper abdominal viscera may be intensely painful and injurious to the patient's morale. Formerly division of the posterior sensory spinal roots or section of the anterolateral pain tract in the spinal cord were the only neurosurgical methods which could relieve continuous suffering and prevent addiction to morphine. Investigation by paravertebral block in the last fifteen years has shown that such radical surgery is often unnecessary and can be superseded by more selective resection of the lower thoracic ganglia and splanchnic nerves. Ordinarily resection of these structures, as is done in the surgical treatment of hypertension, has been the procedure of choice, but at times the general condition of the patient was so poor, owing to the cachexia of advanced malignancy or coronary disease, that no form of major surgery was possible. A number of patients in this precarious state have been given comfort for the remainder of their lives by chemical block of the paravertebral ganglia with procaine and alcohol.

have

Mall

wick

pathways by paravertebral procaine block and their subsequent permanent interruption is summarized in Table 2. Examination of these data shows that many of these painful states represent new and unusual problems. While relief could have been obtained by high anterolateral cordotomy, some of these patients would have been extremely poor operative risks and in all interruption of the viscerosensory nerves was a far simpler and less mutilating procedure. However, without preliminary demonstration of the ramus concerned with the conduction of pain by paravertebral block this type of selective viscerosensory neurectomy would never have been possible.

In addition to the chronic varieties of upper abdominal pain produced by known visceral disease, Archibald,²¹ Scrimger²² and Dr. W. J. Mixer and I²³ have encountered certain cases of obscure abdominal pain where even exploratory laparotomy had failed to demonstrate the causative factor. In a number of instances of this sort where the

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nicectomy, after all other forms of medical therapy and numerous

ysms of the aortic arch. The first case was particularly interesting because the pain was referred to the right upper chest, shoulder neck, and scalp—that is, over the cervical as well as the highest intercostal nerves (Fig 392). All pain was relieved for thirty six hours by paravertebral procaine injection of the first and second thoracic ganglia, although there was no detectable anesthesia of the skin. A subsequent injection with 95 per cent alcohol gave the patient com

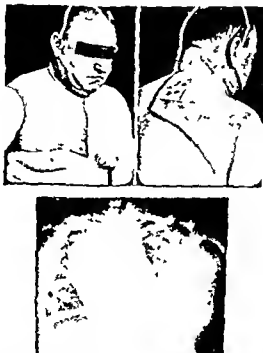


Fig 392—X ray of large aneurysm of ascending arch of aorta which caused continuous intense pain referred to stippled areas in photographs. Needles were inserted at points 1 and 2 against the sides of the two upper thoracic vertebrae. Procaine block gave immediate temporary relief and lasting interruption of pain followed subsequent injection of alcohol.

plete relief for the remaining three months of his life. In this instance right sided pain was caused by an aneurysm of the ascending arch of the aorta, whereas in the two subsequent cases the aneurysms involved the transverse and descending portions of the arch. Here the pain was left sided. These three patients were all given satisfactory relief, which in the case of the longest survivor lasted until his death five and one half years later. Reichert²⁸ has relieved the pain from

TABLE 3

CASES OF INTRACTABLE PERIPHERAL NEURALGIA RELIEVED BY PARAVENTRAL BLOCK AND SYMPATHECTOMY

Condition	Number of Cases	Paravertebral Block	Operation	Result
Causalgia following peripheral nerve injury	14	Diagnostic procaine block in all	Preganglionic upper thoracic or lumbar sympathectomy (Drs White, W Heroy and E Goodman)	Complete relief in 13 partial relief in 1, no deaths or serious complications
Post-traumatic arthritis with osteoporosis	2	Procaine block only (Drs H H Faxon and White)		Permanent relief in 1st patient following carpal fracture after 3 injections Permanent relief in 2nd patient with carpal fracture following single procaine block.
Amputation stump neuralgia	1	Diagnostic procaine block. (Dr E Ifamlin, Jr)	Resection L ₁ -L ₂ ganglia	Complete relief in patient with Sudeck's atrophy of ankle and foot without trauma
	2	Diagnostic procaine block	Upper thoracic sympathectomy	Excellent results following upper thoracic ganglionectomy in 2 men with painful finger stumps One had partial recurrence following return of vasoconstrictor tone
	1	Diagnostic procaine blocks	Resection L ₄ and L ₅ ganglia	Permanent relief of painful amputation stump of great toe

TABLE 2

CASES OF INTRACTABLE ABDOMINAL PAIN RELIEVED BY PARAVERTEBRAL BLOCK AND SYMPATHETOMY

Cause of Pain	Location of Pain	No of Cases	Paravertebral Block	Operation	Result
Posterior duodenal ulcer with erosion into pancreas. Advanced coronary disease prevented resection of ulcer (Smithwick)	R upper quadrant and back	2	Procaine and alcohol T ₁ -T ₁₂ (II)		Complete relief Case 1 Until death from coronary thrombosis at 11 mos. Case 2 Until last report at 8 mos
Irritable colon with constipation abnormal peristalsis and vomiting (Smithwick)	Agonizing attacks of abdominal colic	1	Procaine L ₄ and L ₅ bilateral	Bilateral splanchnicectomy and resection of upper lumbar sympathetic ganglia	Complete relief
Metastatic carcinoma of liver following radical mastectomy (White)	Continuous pain in R side of abdomen in woman sensitive to morphine.	1	Procaine and alcohol T ₁ -T ₁₂ (II)		Complete relief for remaining 2 weeks of life.
Post-operative stenosis of biliary ducts (Smithwick)	R upper quadrant	1	Procaine block splanchnic rami (II)	R splanchnicectomy and resection of lower thoracic sympathetic ganglia	Complete relief
Multiple pancreatic calculi (Smithwick Moore and White)	R upper quadrant and flank	2	Procaine T ₁ -T ₁₂ (II) followed by relief for 2 hours	R splanchnicectomy and resection of 6 lower thoracic sympathetic ganglia	Excellent result in 1st case In 2nd, relief of pancreatic pain appeared effective at 1 mo., but was complicated by intercostal neuralgia. Patient could not be followed longer

* A recent article by Dr. Mallet-Guy of Lyons reports similar successful relief of pancreatic pain

result in further improvement with more prolonged periods of freedom from discomfort and that ultimate lasting recovery may be attained without recourse to actual operation (3) When sympathetic block with procaine has given complete relief for only a short interval upper thoracic sympathectomy or resection of the lumbar ganglia is reasonably certain to succeed In the case in which diagnostic block has been followed by no response sympathectomy is not likely to succeed and some other course of treatment should be adopted

Experience in the recent war^{41 42 43} has further emphasized the importance of preliminary procaine block in order to avoid useless operations as these invariably lead to a further deterioration of the patient's morale⁴⁴ Some of the results at the Massachusetts General Hospital and my personal experiences at two Naval hospitals are summarized in Table 3 and have been recorded in further detail in other publications^{45 46 47}

PROCAINE BLOCK OF THE VASOCONSTRICTOR FIBERS

In 1930 I reported that the sympathetic vasomotor fibers could be blocked temporarily by procaine as effectively as by direct operation^{48 49} Two preliminary papers following a year's period of clinical use showed that maximal vasodilatation can be brought about by paralyzing the sympathetic fibers in the anterior spinal roots (spinal anesthesia) by injecting procaine around the upper thoracic or lumbar sympathetic ganglia (paravertebral block) or by infiltrating the vasoconstrictor axones in the principal nerves to the extremities (peripheral nerve block) A few weeks before the appearance of the first paper Brill and Lawrence⁵⁰ reported the use of spinal anesthesia for determining the degree of vasoconstriction in the lower extremities and shortly thereafter Morton and Scott⁵¹ published further studies showing the value of spinal block Later they advocated peripheral injection of the posterior tibial ulnar or median nerves as the simplest method of estimating the vasodilator response A year previously Sir Thomas Lewis⁵² had advocated blocking the ulnar nerve at the elbow to determine the effect of sympathetic activity on the peripheral states of arteries in a given portion of the limb is of great importance

These methods have stood up well under the test of time and continue to be the most effective tests for determining the degree of vasoconstrictor tone and differentiating between states of excessive vasoconstriction and occlusive vascular disease Except for the recent substitution of differential spinal block for full spinal anesthesia a method devised at this hospital by Sarnoff and Arrowood⁵³ there have been no important modifications in these procedures

ill advised abdominal operations had failed. In a case in which an operation was performed by Dr. Mixer and me the patient has remained well for six years.

In testing out unusual varieties of pain of any sort it is advisable to repeat the injection of procaine on more than one occasion and also to make sure that inert saline is not equally effective. In many of these cases of obscure pain, especially when complicated by drug addiction, it is essential to make certain that the complaints are not, in part at least, the result of a functional disturbance. It is only by taking precautions of this sort that failures can be avoided and the patient's morale not be further impaired by ill advised surgery. In general, however, we have been pleasantly surprised to find how often the neurotic appearing victim of intractable visceral pain has responded and been transformed into a stable individual as soon as his chronic discomfort has been relieved.

Paravertebral Procaine Block in the Study of the Post traumatic Neuralgias.—The intense discomfort of causalgia,¹⁰ post traumatic arthritis with osteoporosis,^{36, 37} and the diffuse aching or burning pain that sometimes follows peripheral amputations* in individuals with chronic cold, sweaty extremities³⁸ can often be relieved by paravertebral procaine block (Table 3). The publications of Leriche³ and Luzuy³¹ on this subject are of particular interest and should be read by all surgeons who are concerned with these problems. Some of the more fortunate cases, especially those with post traumatic arthritis and others classified by Homans⁴⁰ as "minor causalgia" may recover after one or more paravertebral injections of procaine. Others in whom

and disabling, preliminary injection with procaine is an extremely important procedure, as it indicates with a high degree of certainty which individuals will do well with chemical or surgical interruption of the sympathetic fibers.

The criteria for evaluating the role of the sympathetic innervation in the post traumatic neuralgias, which should be followed with care are as follows: (1) Relief during the period of effective sympathetic block with procaine must be complete. (2) The persistence of relief for a period of over two hours indicates that repeated injections may

3 Thanks to investigation with paravertebral block it has been possible to develop effective methods of viscerosensory denervation which carry a minimum of risk and do not disturb cutaneous sensation

4 Statistical data are presented which demonstrate the high degree of effectiveness of sympathectomy after temporary relief of pain by paravertebral injection of procaine Intractable painful states which can be relieved by these means include angina pectoris aortic aneurysm certain lesions of the gastrointestinal tract distention of the biliary and pancreatic ducts causalgia painful osteoporosis and some types of painful amputation stumps

5 Procaine block of the sympathetic fibers serves to differentiate states of excessive vasoconstriction from arterial occlusion Temporary release of vasoconstrictor tone however often fails to detect the case with occlusion of the major arteries which will show a gradual favorable response through permanent dilatation of patent collateral vessels

ACKNOWLEDGMENT

It is a great pleasure to acknowledge my debt to René Leriche professor at the Collège de France and member of the Institut in whose laboratory in Strasbourg the inspiration for this study was obtained. I also wish to express my sincerest thanks to Dr R H Smithwick for permitting me to include many of his cases in this paper more particularly for his constant interest and stimulating help in these

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- 5
- 6 White James C Diagnostic Blocking of Sympathetic Nerves to Examine the
- 7 Mc

All of these methods temporarily paralyze the tonic sympathetic vasoconstrictor impulses and give a quantitative measure of the elevation in peripheral temperature which can be expected to follow sympathectomy. We have come to feel that paravertebral block is the best of all the available methods of testing the degree of vasoconstriction. It is safer than spinal anesthesia, less disturbing to the patient than the earlier method of vasodilatation induced by intravenous injections of foreign protein, and more sure to result in maximal release of vasoconstrictor tone than either peripheral nerve block or body heating.

The method demonstrates to the patient as well as the surgeon the degree of warming as well as the elimination of increased sweating which bothers so many individuals with excessively cold, discolored and clammy extremities. In typical Raynaud's disease it will demonstrate the case with a serious degree of endarteritis of the digital vessels secondary to scleroderma. In patients who are free from serious obliterative endarteritis the results of lumbar block tally quite exactly with the permanent temperature levels following resection of the lumbar ganglia, but the temporary rise in cutaneous temperature induced in the fingers and hand is somewhat greater than the permanent result of sympathectomy.

1. The accuracy of the ultimate postoperative improvement in circulation have not been consistently borne out. While some 90 per cent of patients with obliterative vascular disease in whom the popliteal pulse is present will show a rise in temperature of the foot following paravertebral or spinal block, when the popliteal pulse is absent the great majority will have no post injection rise. Nevertheless some 40 per cent of this group will have a good response following resection of the three upper lumbar sympathetic ganglia. It is evident that a vasoconstrictor block of short duration does not permit full development of blood flow through patent small collateral vessels. Perhaps this difficulty will be overcome through the production of safe, longer lasting anesthetic drugs.

SUMMARY AND CONCLUSIONS

1. Diagnostic injection with procaine hydrochloride is a valuable method for studying the pathways over which unusual varieties of pain are transmitted to the brain and for determining the role of vasoconstriction in states of poor circulation in the extremities.

2. Paravertebral block of the sympathectomy

ARTHRODESIS OF THE ANKLE FOR CORRECTION OF FOOT DEFORMITY

JOSEPH S. BARR, M.D.* AND EUGENE E. RECORD, M.D.†

THE purpose of this paper is to call attention to the fact that certain long standing foot deformities in adults, particularly those of the equinovarus type, may be very satisfactorily corrected, and an excellent functional and cosmetic result obtained by arthrodesis of the ankle.

Introduction—The commonly accepted indications for arthrodesis of the ankle are malunited fractures, traumatic or infectious arthritis and tuberculosis involving the joint. The result of ankle stabilization (a term used synonymously with arthrodesis) in such cases is extremely satisfactory, both functionally and cosmetically. There is no pain, the contour of the ankle and foot is essentially unchanged, there is an excellent gait and in many instances the patient can walk and even run in normal fashion. There is surprisingly free range of motion of the foot. Some compensatory increase in dorsal and plantar flexion occurs in the midtarsal and subtalar joints so that there may remain about one half the normal range of motion formerly present in the ankle. The fact that the operation of ankle stabilization has been shown to yield excellent functional and cosmetic results is not generally appreciated even among experienced orthopedic surgeons. The laity and the medical profession generally continue to regard this "stiffening operation" with the greatest distrust and apprehension.

The common weight bearing position. Stabilization of deformed feet by these methods (triple arthrodesis of the Hoke or Dunn types) has been reasonably satisfactory, but failures and poor results are not uncommon. The chief cause of failure is abnormal and uncontrolled motion in the ankle joint. The paralysis of the muscles which normally dorsiflex the ankle results in a drop foot gait, even after a properly done triple arthrodesis. In order to prevent this various surgeons have proposed additions to and modifications of the triple arthrodesis. All of these procedures have as their aim limitation of motion of the ankle joint.

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- 51 Lewis, Thomas *Experiments Relating to the Peripheral Mechanism Involved in Spasmodic Arrest of the Circulation in the Fingers, a Variety of Raynaud's Disease* Heart 15 7-101, 1929
- 52 Sarnoff, Stanley J and Arrowood, John C *Differential Spinal Block A Preliminary Report* Surgery, 20 150-159, 1946

upon lengthening the tendo achillis dividing the posterior tibial tendon and stabilizing the foot by triple arthrodesis (Lambrinudi modification) and an anterior tenodesis

Convalescence was uneventful The patient's casts were discarded and ordinary

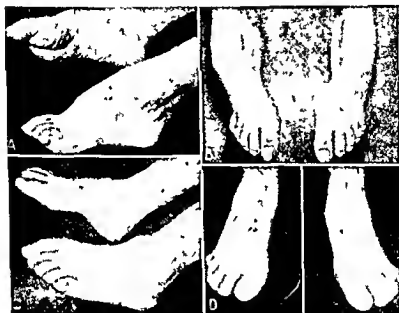


Fig. 393—A, B, Preoperative photographs showing severe bilateral equinovarus deformities C, D, Postoperative photographs An ankle fusion has been done on the right foot A triple arthrodesis (Lambrinudi) and anterior tenodesis has been done on the left foot

There is not more than 2 or 3 degrees motion in pronation and supination in the os calcis There is no ankle joint motion present The foot is held in 20 degree equinus and there is about 10 to 15 degree further motion in equinus which takes

balance

floor

A B

Among the more commonly used modifications are the posterior bone block of Gill and Campbell, the Brewster countersinking operation, the T-tube, and the various modifications suggested by these and have

result study reveals a certain percentage of failure in all of these operations due to pain and instability in the ankle joint and in some instances to recurrence of equinovarus deformity. Subluxation of the talus at the ankle mortise is usually responsible for such recurrence of deformity. In some instances it is necessary to arthrodese the ankle joint in order to relieve pain and disability.

But panarthrodese leaves much to be desired from the functional point of view. Some joint motion in the ankle is necessary for a smooth

The question arises: (1) How much equinovarus deformity occurs in the ankle joint and how much in the other tarsal joints? (2) How much of the deformity can be corrected by doing an arthrodese of the ankle? (3) What is the cosmetic and functional result obtained by doing an ankle fusion alone, leaving the subtalar and midtarsal joints untouched?

A small series of cases with equinovarus foot deformities have been operated upon by ankle fusion supplemented by lengthening of the tendo achillis and other soft tissue work as indicated. Although late end results are not yet available it appears that ankle fusion is equal to or slightly superior to triple arthrodese on the score of both function and cosmetic results.

The following case report is of interest as both feet had similar severe equinovarus deformities which were treated by ankle fusion on one side and triple arthrodese (Lambrinudi) on the other.

CASE REPORT—L. C. (M. G. H. No. 519751) on 12-1-17

and fibula and immobilizing the joint in proper position by a sliding bone graft

The operation is performed under a tourniquet. In cases with severe deformities (equinovarus and cavus) subcutaneous plantar fasciotomy and lengthening of the tendo achillis by triple hemisection after the method of Hatt is done as the first step.

An anteromedial skin incision is then made, beginning at the insertion of the anterior tibial tendon and extending proximally 4 or 5 inches directly over the tendon. Its sheath is incised, the tendon retracted and the incision carried down to bone. By subperiosteal dissection, the internal malleolus is cleared of all ligamentous attachments. The posterior tibial tendon is identified and sectioned. The mesial and anterior aspects of the talus and of the distal tibia are then thoroughly freed of all capsular and ligamentous attachments.

A second 3 inch skin incision is then made over the distal fibula, carried down to bone and the ligaments are stripped off the external malleolus and lateral aspect of the talus. The ankle joint can now be thoroughly visualized and the articular cartilage is completely removed by means of the osteotome, sacrificing as little bone as possible. Upon completion of this step, the equinovarus deformity is easily corrected by rotating the foot and tibia on the tibia and fibula bones

somewhat posteriorly so that the neck of the talus lies beneath the anterior margin of the distal tibia.

The distal tibia is then cut, turning up of ligaments and a small amount of the

it is deformity and exact placement of the foot in the desired position for arthrodesis. It is unnecessary to sacrifice more than a minimal amount of bone. In no case has it been necessary to resort to midtarsal wedge resection or supramalleolar osteotomy to secure additional correction.

A bone graft is then cut from the tibia according to the technic described by Brittain. It is driven beneath an anterior bridge of bone across the joint line into a slot cut in the talus. This securely fixes the joint surfaces. Additional chips of bone are packed about the lateral recesses of the joint. In a few instances the distal fibula has been obliquely osteotomized and displaced inward to secure better coaptation.

The wounds are closed carefully with silk and a plaster cast applied from the toes to the groin with the knee flexed about 20 degrees.

Postoperative Care.—The skin sutures may be removed on the tenth postoperative day through a window or the cast may be bisected. At the end of six weeks, a below the knee boot with a walking iron is applied and partial weightbearing with crutches is permitted.

of the foot. The lack of broadening below the malleoli makes it a little easier to fit his shoe on the right foot."

Preoperative and postoperative x rays of the right foot are shown in Figure 394



Fig 394 -A, Preoperative x ray of right foot. Note complete equinus position
B Postoperative x ray showing solid bony fusion

Textbooks of anatomy state that there is, in the normal foot, little or no pronation supination motion in the ankle joint and that it is essentially a hinge joint, permitting only dorsal and plantar flexion. Careful roentgenographic and clinical examination of a number of feet which for long periods of time have been in equinovarus deformity reveals that the head of the talus has rotated downward and medially and the body of the talus has supinated in the ankle joint. Although some of the deformity occurs in the subtalar and midtarsal joints, the major factor is a distorted tibiotalar articulation. Experience with this small group of cases has convinced the authors that

(1)
tibial

tendon (2) Complete subperiosteal stripping of capsule and ligaments from the talus and from the distal tibia and fibula anteriorly, laterally and medially at the ankle joint (3) Resection of all articular cartilage from the ankle joint (4) Correction of the deformity by rotating the foot and talus as one unit on the denuded distal tibia

Full weight bearing in the cast is allowed after two more weeks and the cast is removed ten weeks after operation. An ordinary shoe is then fitted paying particular attention to correct heel height. Training in proper rhythm and coordination in walking is essential to a satisfactory result.

Selection of Cases—The deformities thus far treated by this method are those of equinus, equinovarus and equinovarus with cavus. Calcaneus and calcaneovalgus deformities should also be suitable for this procedure.

All patients have been adults without sufficient muscle power to permit active dorsiflexion of the foot and with no muscles suitable for transplanting. The operation is not advised for children or adolescents.

The diseases producing the deformities include anterior poliomyelitis, Friedreich's ataxia, spina bifida and congenital club foot.

Results—In each case in this small series (Table 1) there has been excellent immediate correction of the deformity and thus far there have been no recurrences. The cosmetic result appears to be definitely superior to that obtained by triple arthrodesis as there is no broadening of the hind foot and no shortening of the foot. There have been no failures of ankylosis. The functional results appear to be most satisfactory. The feet are stable in good weight bearing position and require no brace or other apparatus. The range of motion in dorsal and plantar flexion is

normal. There is no abnormal motion to be good both in the foot and ankle. I emphasize that this is a preliminary report and that a sufficient length of time has not yet elapsed to permit any statement to be made concerning late end results.

SUMMARY

The commonly accepted reconstruction operations for severe equinovarus deformities of the feet frequently give unsatisfactory results. Attention is directed to the fact that equinovarus deformity occurs primarily at the ankle joint and can be corrected by arthrodesis of this joint supplemented by appropriate release of soft tissue contractures. The cosmetic and early functional results obtained in a small series of cases treated by arthrodesis of the ankle have been most satisfactory and appear to warrant its further trial.

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TABLE 1

Case	Initial Unit No	Age	Disease	Deformity	Date and Type of Operation	Follow up Date and Result
1	L. F. 567005	43	Sp on b fida occulta tumor cauda equi on (dermo d)	Tail pos equo varus severe b lateral	2/4/47 D via on of tendo ach ill a and post tub al tendon arthrodesis of the ankle. 2/19/47 Resect on of metatarsal heads (bilateral)	
2	C. W. 443124	12	Sp on l fida occ lta congenital club foot	Congen al equo ovar- nus right foot, old part al astragalectom- y	6/15/46 Arthrodesis, right ankle.	4/8/47 Good weight-bearing position of both feet
3	I. H. 537319	45	Old pol onychitis	Equo podocavovarus r al t foot (dis l)	1/9/47 Arthrodesis, r gl t ankle.	2/23/46 No pain 15° equo nus, r gl t foot 18° degrees compensatory midlateral motion excellent p s t w shoulder lateral ah f t of feet on l t n and l hula
4	F. H. 576223	31	Old pol onychitis	Equo varus left foot	6/3/46 Arthrodesis, right ankle tenotomy pos- ter or tub al tendon lengthening of tendo ach ill a.	4/8/47 Solid fusion Good comfort a result.
5	A. W. 407158	31	R lateral rupture of intervertebral disk L4	Equo varus, right foot	6/7/46 Arthrodesis, right ankle	9/6/46 No pain plantar flexion locks a-10 de- grees foot in excellent position
6	L. C. 519 51	18	Fr edre ch a etas a	Equo varus (bilat- eral)	6/11/46 Arthrodesis, right ankle, d via on post- tibal tendon tendo ach ill a lengthening	1/6/47 Normal gait, Good comfort a result. Foot 15 degrees equinus. No pain.
7	R. S. 539452	25	Nerve injury	Equo varus, r gl t foot lambshead (Jan 1945) traumatic arthritis, right ankle	10/24/46 Arthrodesis, right ankle	2/14/47 No pain, right ankle excellent weight bearing position ankle a l l n 10-15 degrees com- pensatory midlateral motion Foot in in -10 degree of equo nus. Good take-off when walk ng
8	W. C. 515837	33	Old pol onychitis	Equo varus left foot.	9/19/46 Arthrodesis left ankle oblique osleo- tomy iliacus	3/11/47 Very slight varus forefoot callus over 1 1/2 in lateral head walks without pain and with improved gait, foot 15 degrees equo nus.
					4/4/47 No pain, 15 degrees equo nus, left foot 15- 20 degrees subtalar and midlateral motion stable ankle normal contour of foot and a kl	

CAPSULAR REPAIR FOR RECURRENT DISLOCATION OF SHOULDER PATHOLOGICAL FINDINGS AND OPERATIVE TECHNIC

EDWIN F. CAVE, M.D. F.A.C.S.* AND CARTER R. ROWE, M.D.†

It is probable that more operations have been suggested to correct recurring dislocation of the shoulder than for any other condition requiring orthopedic surgery. This fact indicates that no one procedure has produced satisfactory results in a high percentage of cases. Hence the continuous striving for some operation that will be uniformly successful.

Muscle transplants and tendon substitutes have been received with enthusiasm when first tried, but all have failed in a higher percentage of cases than do most surgical procedures. Prior to Bankart's capsular repair, Nicola's operation, consisting of transplanting the biceps tendon through the head and neck of the humerus, was the best operation. This is easily performed and seemed to be successful in most cases. As years went by, however, there were more and more recurrences because of rupture and fraying out of the transplanted biceps tendon either at its point of exit from the tunnel in the humeral neck or at its point of entrance into the humeral head.

The operation advocated by Bankart¹ has appealed to the authors as being the most logical procedure suggested thus far. We also agree with Bankart as to the site of the lesion in the majority of cases. The lesions consistently found have been fracture and fraying of the glenoid labrum and complete separation of the capsule from the glenoid along the anterior and inferior portions. In some cases only small fragments of the cartilaginous labrum remained. The bony rim of the glenoid there were small consistently in this point.

Bankart's operation is not as easily performed as most procedures advocated for recurrent shoulder dislocation, but it is logical and we believe that the time consumed in doing the operation is well spent for to date our known results have been gratifying.

We do not propose to give end results in this short paper. What we do wish to accomplish is to state our belief in the soundness of the

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Recurrent posterior dislocations occurred in three of the twenty five cases (12 per cent). Only one of these presented traumatic changes similar to those found in the anterior dislocations.

OPERATIVE TECHNIC

This is essentially Bankart's procedure with a few modifications which we believe are improvements in technique.

1 Incision begins along the outer third of the clavicle at the level of the coracoid process. It is then carried downward and outward so as to avoid proximity to the axilla (Fig. 395).

capsular repair of the shoulder, and to describe certain characteristic pathological findings and the technic of the operation as we have done it, pointing out particularly some of its attendant difficulties

PATHOLOGICAL FINDINGS

In our series of 17 cases, 15 of which were pre-traumatic and 2 of which were traumatic, the following findings were present:

These three findings were confined to one area in anterior dislocations—namely, the anterior inferior aspect of the joint. In only two cases was there a tear through the anterior capsule *per se*, and these were large rents along the anterior inferior aspect of the capsule.

The labrum was completely destroyed anteriorly in nine cases. In the other twelve cases moderate damage was present in eight cases, i.e. thinning or shredding of the cartilage or multiple small fractures or tears, the main portion of the labrum remaining intact. In the remaining four cases there was mild trauma consisting of early disintegrative changes.

Injury to the bony rim of the glenoid was noted in fifteen cases (60 per cent). The rim was severely eroded and eburnated in eight cases, and in one of these there was an avulsed fracture of the rim at the capsular border. In four cases there was a moderate degree of trauma, and in three cases there were slight or early changes.

In fourteen cases (56 per cent) the joint capsule was completely torn from its attachment to the rim of the glenoid. Thirteen of these tears were in the anterior and anterior inferior portion of the glenoid, and one in the superior portion.

The separation of the capsule from the glenoid rim may not be recognized easily and it is well in each case to pass a blunt instrument along the anterior rim of the glenoid to determine the presence or absence of capsular separation.

In two joints cartilaginous loose bodies were found originating from the glenoid labrum in one case and from the head of the humerus in the other.

In five cases (20 per cent) there had been previous Nicola repairs performed. In two of these the biceps tendon had separated at the suture line; in two others the biceps tendon was thinned and stretched but intact. The anterior deltoid muscle was atrophied in two cases in which a muscle-splitting incision had been used.

In four cases with anterior dislocation there was no evidence of trauma in the joint.

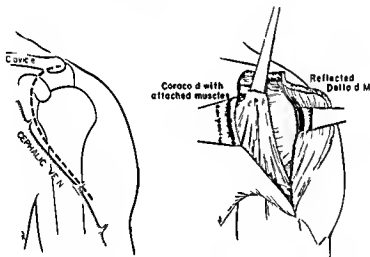
Recurrent posterior dislocations occurred in three of the twenty five cases (12 per cent) Only one of these presented traumatic changes similar to those found in the anterior dislocations

OPERATIVE TECHNIC

This is essentially Bankart's procedure with a few modifications which we believe are improvements in technic

1 Incision begins along the outer third of the clavicle at the level of the coracoid process It is then carried downward and outward so as to avoid proximity to the axilla (Fig 395)

2 Dissection is made between the pectoralis major and the deltoid muscles retracting the cephalic vein toward the midline with the muscle fibers of the pectoralis major



SKIN INCISION

OSTEOTOMY OF CORACOID PROCESS
Fig 395

3

This

4

attachments, the short head of the biceps the pectoralis minor and the coracobrachialis are exposed

5 With a very small gouge ($\frac{1}{8}$ inch diameter) a hole is made through the long axis of the coracoid process for a distance of 1 inch This will simplify the securing of this bone in the closure

6 Using a small sharp osteotome ($\frac{3}{8}$ inch), the coracoid is cut across and this bone fragment and its muscle attachments turned slightly downward and medially Osteotomizing the coracoid mini

capsular repair of the shoulder, and to describe certain characteristic pathological findings and the technic of the operation as we have done it, pointing out particularly some of its attendant difficulties.

PATHOLOGICAL FINDINGS

In our series of twenty-five cases, the following pathological findings were present:

- Trauma to the capsular attachment

These three findings were confined to one area in anterior dislocations—namely, the anterior inferior aspect of the joint. In only two cases was there a tear through the anterior capsule *per se*, and these were large rents along the inferior border of the subscapularis muscle.

The most consistent finding was trauma to the cartilaginous labrum. This occurred in twenty-one of the twenty-five cases (84 per cent). The labrum was completely destroyed anteriorly in nine cases. In the other twelve cases moderate damage was present in eight cases, i.e. thinning or shredding of the cartilage or multiple small fractures or tears, the main portion of the labrum remaining intact. In the remaining four cases there was mild trauma consisting of early disintegrative changes.

Injury to the bony rim of the glenoid was noted in fifteen cases (60 per cent). The rim was severely eroded and eburnated in eight cases, and in one of these there was an avulsed fracture of the rim at the capsular border. In four cases there was a moderate degree of trauma, and in three cases there were slight or early changes.

In fourteen cases (56 per cent) the joint capsule was completely torn from its attachment to the rim of the glenoid. Thirteen of these tears were in the anterior and anterior inferior portion of the glenoid and one in the superior portion.

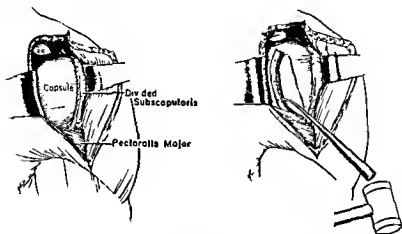
The separation of the capsule from the glenoid rim may not be recognized easily, and it is well in each case to pass a blunt instrument along the anterior rim of the glenoid to determine the presence or absence of capsular separation.

In two joints cartilaginous loose bodies were found, originating from the glenoid labrum in one case and from the head of the humerus in the other.

In five cases (20 per cent) there had been previous Nicola repairs performed. In two of these the biceps tendon had separated at the suture line, in two others the biceps tendon was thinned and stretched but intact. The anterior deltoid muscle was atrophied in two cases in which a muscle-splitting incision had been used.

In four cases with anterior dislocation there was no evidence of trauma in the joint.

12 A sometimes difficult step is the making of three holes through the bony rim of the anterior glenoid. These are made with a pointed curved spike (Fig 397) which has been found very useful



SUBSCAPULARIS REFLECTED MEDIALY

HOLES THROUGH RIM OF GLENOID

Fig 397

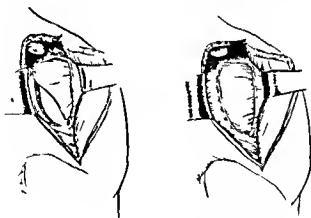
SECURING LATERAL CAPSULAR FLAP
WITH HEAVY SILK SUTUREFOLDING OF PROXIMAL FLAP OVER
LATERAL CAPSULAR FLAP

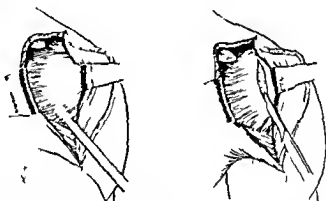
Fig 398

13 While holding the humerus in 45 degrees abduction and 10 degrees external rotation, the lateral capsular flap is sewed to the glenoid through the three drill holes with heavy silk (Fig 398)

mizes the tension on these muscles which is necessary for retraction and eliminates the possibility of injury to the musculocutaneous nerve from the . . .

is rotated externally, and the insertion of the subscapularis to the lesser tuberosity is identified

8 This is a most difficult and important step in the operation. The lower border of the subscapularis is identified by a plexus of veins which is secured with suture ligatures. Separation of the inferior border of the muscle is done with a blunt dissector which is passed deep to the muscle and carried laterally to the musculotendinous junction



MUSCLES TO CORACOID REFLECTED
MEDIALY—BLUNT INSTRUMENT
IDENTIFIES LOWER BORDER OF
SUBSCAPULARIS MUSCLE

DISSECTION OF SUBSCAPULARIS FROM
LESSER TUBEROSITY AND CAPSULE

Fig 398

with the capsule. The subscapularis must be dissected carefully from the underlying capsule and divided from its attachment to the lesser

glenoid rim for a distance of about 2 inches. This allows adequate exposure of the joint and sufficient mesial capsule is left to overlap in the capsular repair (Fig 397).

11 The anterior margin of the glenoid is "freshened" by the use of a sharp osteotome or curette.

HALLUX VALGUS, WEAK FOOT AND THE KELLER OPERATION: AN END-RESULT STUDY

WILLIAM A. ROGERS, M.D., F.A.C.S.* AND ROBERT J. JOPLIN, M.D., F.A.C.S.†

It is well known that structural and functional changes are commonly found in the foot, associated with hallux valgus. These accompanying alterations may be marked. They are often painful and always weaken the foot. They occur especially in the metatarsal and digital regions where they include metatarsophalangeal contractures, calluses, and exostoses, with associated bursitis. Varus of the first four metatarsals and splay foot are common. In addition, pronation and muscle contracture and stretching usually coexist.

Incorrect design and fitting of shoes together with disuse and overweight, are essential causative factors in the formation of both the hallux valgus and the associated disorders.

Somewhat similar changes are found arising out of congenital anomalies of bony structure. These constitute a separate group etiologically, and are not included in this study.

Any plan of treatment directed to the correction of the hallux valgus must also include measures to correct the associated changes in the foot if optimum results are to be attained.

The Keller operation,² when correctly performed, may be expected to result in a pain free great toe joint provided correct shoes are worn for the most part and too great demands on the foot are not made. Through it the first metatarsal exostosis and troublesome overlying bursa are eliminated and the problem of fitting shoes is reduced to a minimum. The operation does not restore the strength of the great toe, essential to normal locomotion and it does not effect significantly a correction of the weakness that usually coexists in the foot as a whole. There is good evidence that the Keller reconstruction throws upon the rest of the foot a burden as great as or greater than that imposed by the deformity for which the operation was performed. Its value is therefore limited and is in large measure local.

Correct shoes, exercises and various forms of support have proved helpful before and after operation. Surgically, the Keller operation while gratifying in the respects enumerated falls short physiologically,

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14 The subscapularis muscle is resutured to its tendon

15 The detached coracoid process (having previously been drilled) is resutured to its base with one heavy silk stitch

16 Closure of the wound is completed with fine cotton or silk

After operation the arm is immobilized with a Velpeau bandage or sling and swathe for ten days and supported with a sling for an additional two weeks. Motion to the horizontal plane is allowed in six weeks and by the end of eight weeks it is expected that there will be only slight restriction in abduction and external rotation which if permanent is probably a good thing.

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4 Retraction, dorsally, of the three middle toes was common. The position had persisted over a period sufficient to establish recognizable joint contractures in 75 per cent. Passive correction to neutral of the three middle metatarsophalangeal joints was not possible in about 30 per cent. In the more severe cases abduction contracture was combined with that of retraction (Fig 399). Sixty per cent of the series fell in this category. It was clearly apparent that these metatarsophalangeal



Fig 399—Notable are the valgus of the first three toes of both feet, the retraction of the second, third and fourth toes, and the varus of the first three metatarsals. Exostoses have formed on the outer aspect of the heads of the first and fifth metatarsals. With these are associated painful overlying bursitis and callus. Mild degenerative changes are present in both great toe joints.

and toe contractures were, in large measure, the result of adaptation to too short, pointed shoes since the contour of the forefoot conformed so exactly to that of the front of the shoe worn. Hammer-toe deformity of the second digit was found in 4 per cent of the series.

5 No record was made preoperatively of voluntary control of the intrinsic muscles of the foot in this series. It is, however, our experience that this function is not returned as a rule in this group. In many it may be regained, in others it seems permanently lost.

does not restore structure, and does not include correction of the associated functional and structural weaknesses of the foot

The accuracy of the foregoing observations seems to be amply at

called All of these patients had been operated upon for hallux valgus or hallux rigidus by various members of the orthopedic staff of the Massachusetts General Hospital, both visiting and resident, between the years 1938 and 1946, inclusive The results noted during that study constitute the basis of this report

The Sample.—Of the fifty patients included in the study, 80 per cent were between the ages of 35 and 65 and 90 per cent were women Six were young women in the teens, seeking relief from pain and a good cosmetic result Of the entire group only three were engaged at the time of surgery in occupations requiring them to be on their feet constantly during the working hours of the day Surgery was bilateral in thirty-six and unilateral in thirteen, making a total of eighty five feet operated upon Hallux rigidus was diagnosed in four, there was one of combined hallux rigidus and valgus and the other forty five had hallux valgus of varying degree The average duration of follow up was four years in twenty seven it was between one and four years inclusive and in twenty three between five and nine years inclusive

PREOPERATIVE FINDINGS

Etiology.—In the absence of predeformity examination or a convincing statement from the patient it was not possible to determine reliably preexistence of varus of the first metatarsal The evidence was convincing however that too short shoes contributed heavily to both the deformity of the great toe joint and to the weak foot. Notable exceptions were two women who had short broad feet, and in spite of correct length of shoe painful exostoses and bunions developed and two men with hallux rigidus one evidently traumatic, and one from osteochondromas Thirty per cent of the patients were markedly overweight and 27 per cent were overtired housewives many of whom were obese

Accompanying Evidence of Weak Foot—In every one of the fifty patients one or more definite signs of weakness of the foot other than hallux valgus were present at the time of surgery Preoperative exam

was slight in 19 per cent, mod
per cent

2 Contracture of the triceps surae was present in 58 per cent

3 Callus beneath the heads of one or more of the three middle metatarsals was present in 63 per cent

4 Retraction, dorsally, of the three middle toes was common. The position had persisted over a period sufficient to establish recognizable joint contractures in 75 per cent. Passive correction to neutral of the three middle metatarsophalangeal joints was not possible in about 30 per cent. In the more severe cases abduction contracture was combined with that of retraction (Fig. 399). Sixty per cent of the series fell in this category. It was clearly apparent that these metatarsophalangeal



Fig. 399—Notable are the values of the second toe. The second toe is in a position of retraction. Exostoses of the second metatarsals. With degenerative changes are present in both great toe joints.

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5 No record was made preoperatively of voluntary control of the intrinsic muscles of the foot in this series. It is, however, our experience that this function is not retained as a rule in this group. In many it may be regained; in others it seems permanently lost.

6 Pain localized in regions of the foot other than the great toe joint and great toe was present in 62 per cent. It was not complained of in 38 per cent. The ball of the foot was painful in 42 per cent, by far the most common localization. Pain in the great toe or great toe joint was present preoperatively in 98 per cent.

Metatarsodigital Derangements—In 75 per cent of the cases there was dorsal retraction of the middle three toes in 60 per cent dorsal retraction was combined with valgus of these toes. When digital val-

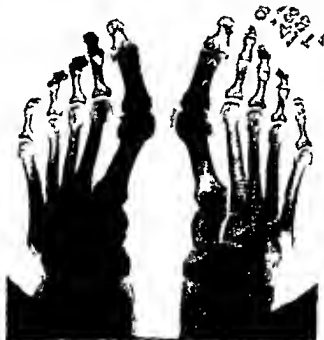


Fig. 400—Note varus of the first three metatarsals and valgus of the fifth metatarsal. The fifth toes are in valgus. There is marked spreading of the metatarsal region and the toes are compressed.

gus was present this deformity was always accompanied by metatarsal varus (Fig. 399) when varus of the fifth toe was found there was usually associated valgus of the fifth metatarsal (Fig. 400). The degree of metatarsal deviation corresponded closely with the degree of deviation of the corresponding toe but was opposite in direction. Two sets of forces seem to be involved. The pressure of the shoe appeared to be primary and to result in deviation of either the digit or the metatarsal in one or more directions: medial, lateral, dorsal and ventral. The digital or metatarsal element not primarily affected then

assumed the opposite position. The secondary set of forces appeared to be that of the muscles which activate the toes. Their effect seems to be to maintain the deformity as a bow string, often the metatarsal region becomes fan shaped or splayed. The intrinsic foot muscles invariably suffer, in our experience, when the digital and metatarsal deviations are opposite. Weakening of the normal metatarsodigital mechanism resulted and in a high proportion of cases abnormal pressure points developed resulting in exostoses, calluses, bursitis and pain.

The Great Toe Joint—The changes found in hallux valgus, namely various degrees of abduction and internal rotation of the toe, of degenerative arthritis, of loss of power and motion of exostosis and bursitis, callus and pain are too well known to be repeated.

TREATMENT AND RESULTS

Nonoperative treatment included the use of correct shoes with or without heel lifts. In this regard cooperation was usually unsatisfactory or impossible. Arch supports were almost invariably supplied and were being worn consistently by thirty of the fifty patients in this group at the time of end result examination. Exercises were prescribed and carefully taught but were often carried out indifferently. The reduction of activities requiring being constantly on the feet so conspicuous in the group before surgery was equally notable following surgery. Prolonged standing or walking was not recommended and evidently not possible as a rule.¹

Operative—The Keller operation was performed upon thirty three patients bilaterally in twenty two for a total of fifty five. Four of these were for hallux rigidus alone. The technic followed was essentially that first described by Keller.² The following are the end results found in this series:

1 Pain localized at the great toe joint or in the great toe was present in 11 of 33 feet or 33 per cent. In 11 of 22 feet or 50 per cent.

or 91 per cent. In 11 of 22 feet or 50 per cent. In 11 of 22 feet or 50 per cent. In 11 of 22 feet or 50 per cent. In 11 of 22 feet or 50 per cent.

2 Elimination of the first metatarsal exostosis and bursitis was found to be complete in fifty of the fifty five feet or 91 per cent. The failures again appearing to be the result of too short shoes.

3 The fitting of shoes had been found easier postoperatively in twenty eight of the thirty three patients. The other five had had no trouble in this respect before or after operation.

4 Maintenance of correction of the valgus seemed to depend upon the fit of the shoes. There was less valgus postoperatively in 50 per

6 Pain, localized in regions of the foot other than the great toe joint and great toe, was present in 62 per cent. It was not complained of in 38 per cent. The ball of the foot was painful in 42 per cent, by far the most common localization. Pain in the great toe or great toe joint was present preoperatively in 93 per cent.

Metatarsodigital Derangements.—In 75 per cent of the cases there was dorsal retraction of the middle three toes, in 60 per cent, dorsal retraction was combined with valgus of these toes. When digital val-



Fig. 400.—Note varus of the first three metatarsals and valgus of the fifth metatarsal. The fifth toes are in varus. There is marked spreading of the metatarsal region and the toes are compressed.

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gravated and further abnormal changes ensue. The objective findings at end result examination of these patients showed marked improvement in the foot as a whole in only 9 per cent, there was essentially no objective change in 71 per cent, and abnormal changes were increased in 20 per cent. Pain other than that in the great toe and great toe joint was relieved in 45 per cent, unchanged in 24 per cent, and was increased in 30 per cent.



Fig. 402—Roentgenographic appearance of the feet shown in Figure 399 six years after bilateral Keller operations. Note the displacement proximally of the sesamoids. In spite of extreme structural and functional faults the patient is glad she had the operations because because she has no more pain at the great toe joints. She is, however, forced to sit all she possibly can when not doing her house work because of the weakness of her feet.

7. Sixty seven per cent of the patients continued to wear arch supports and 33 per cent did not.

8. The patients' occupation gave some indication of the functional capacity of their feet. Ninety per cent were employed in sedentary work or in work which permitted periods of sitting. During leisure 74 per cent were sedentary.

cent, about the same degree of valgus as preoperatively in 42 per cent (Fig 401), and the deformity had increased in 8 per cent (Fig 402)

5 Especially notable are the observations with respect to power of the great toe following this operation. The reconstructed push off mechanism appeared weaker after operation than before in 55 per cent,¹ approximately unchanged in 34 per cent, and seemed perhaps to be stronger in only 11 per cent. In the six patients in whom great toe power seemed to have increased, four were cases of hallux rigidus. Obviously, these observations lack precision and an accurate analysis of the mechanics involved is wanting. However, it is doubtless true



Fig 401—Four year end result following bilateral Keller operations for hallux valgus. There is slightly less valgus of the left great toe than there was before operation, on the right the deviation is virtually unchanged.

that weakness of the great toe persists in about 90 per cent of patients who have undergone the Keller procedure.

6 The effect of the Keller operation upon pain and upon the altera-

results from the use of these adjunct measures is attributed by the patient to the operation. When these supplementary measures are not employed, or are omitted, the foot pain present before operation is ag-

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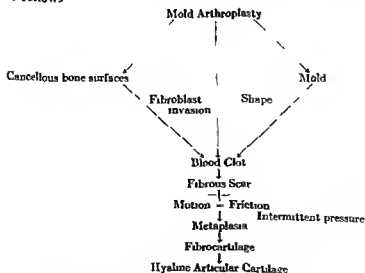
of these faults when instituted following operation are definitely helpful, at least subjectively. Usually the alleviation of pain that results from the use of these adjunct measures is attributed by the patient to the operation. When these supplementary measures are not employed, or are omitted, the foot pain present before operation is ag

PRINCIPLE OF MOLD ARTHROPLASTY AS APPLIED TO THE HIP

M N SMITH PETERSEN, M D, F A C S,* OTTO E AUFRANG, M D †
AND CARROLL B LARSON, M D †

posing a perishable membrane between two imperfectly shaped joint surfaces. The membrane, fascia lata, or other perishable goods used for interposition did not control repair, nor did they retain their structural characteristics under the grinding action to which they were subjected. Since the hip is the fulcrum for the leverage of the strongest muscles in the body, it was inevitable that arthroplasty of this joint based on such a faulty principle, should meet with only limited success.

Mold arthroplasty is based on the principle of interposing an inert mobile mold to guide repair and to act as a nonperishable barrier between perfectly shaped joint surfaces. The mobility of the mold subjects the adjacent surfaces to friction and intermittent pressure, physical factors necessary for physiological repair. The process of healing or repair of the mold arthroplasty may be diagrammatically represented as follows:



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† Assistant Orthopedic Surgeon, Massachusetts General Hospital

9 The mobility of the great toe joint, actively, was increased in 30 per cent, decreased in 30 per cent, and decreased in 30 per cent. Passively, mobility was increased in 30 per cent, decreased in 30 per cent, and decreased in 30 per cent.

and extension of the reconstructed great joint always exceeded the range of these motions carried out actively. The great toe flexors and extensors were not able to regain entirely the normal power. The short flexor sesamoid bones were found invariably to have been displaced proximally. These observations are significant with respect to the loss of the important power of the great toe following this operation.

10 Degenerative joint changes in the great toe joint following operation were found roentgenographically to have increased in 88 per cent, they were unchanged in 12 per cent.

11 Varus of the first metatarsal was unchanged in 90 per cent, it was increased in 9 per cent, and improved in one foot.

12 The average period of incapacity following operation was four weeks.

13 The patients' reaction was distinctly favorable in 70 per cent. One definitely regretted having had the operation. The others were only partially satisfied, feeling disappointed that the foot as a whole was not better.

CONCLUSIONS

The changes which occur throughout the foot in company with hallux valgus, especially in the metatarsal and phalangeal regions, result in significant pain or discomfort and loss of function. These alterations are not relieved by the Keller operation for hallux valgus and only partially by correct shoes, supports and exercises. While the Keller procedure eliminates pain at the great toe joint and makes easier the fitting of shoes, it does not restore the power of the great toe lost through deformity and does not arrest the progress of degenerative joint changes.

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In December 1938 the patient was brought into the hospital for removal of the glass mold. At that time her hip motions were permanent flexion 20 degrees further flexion 105 degrees abduction none, adduction 15 degrees internal rotation none external rotation 15 degrees.

At operation on December 8, 1938, on removal of the glass mold the surfaces of both the head of the femur and the acetabulum were firm and shining.



Fig 404—Upper, Gross specimen of joint three years later following death of patient from a respiratory infection. Lower Microscopic cross section from femoral head showing condensation of subchondral bone and newly formed overlying cartilage.

Specimens were taken from the head for microscopic study. These revealed a fairly fibrotic articular avascular tissue composed of homogeneous matrix embracing columns and clusters of cartilage cells. The arrangement of the cartilage cells is not as

An illustrative case is that of a waitress.

A C.



Fig 403—Upper, Old fracture of acetabulum preoperative view Lower, Two years after glass mold arthroplasty The glass mold was replaced by a vitallium mold.

CARCINOMA OF THE PROSTATE TOTAL PERINEAL PROSTATECTOMY

FLETCHER H COLBY M D F A C S *

ENDOCRINE therapy has had a profound effect upon many cases of cancer of the prostate but unfortunately the experience of the past five years has shown that neither castration nor the female sex hormone cures this disease Regression of the enlarged hard nodular carcinomatous prostate under endocrine treatment is often spectacular the gland no longer feels malignant metastases shrink or disappear and once more the patient feels well After a few months or a few years however the cancer cells become reactivated no longer checked by hormonal influence and symptoms reappear It is well then to review our experiences with radical surgery in the attempt to cure early cancer of the prostate

Many years ago Dr Hugh Young¹ of Baltimore devised and advocated the operation of total perineal prostatectomy as a method of curing selected instances of prostatic cancer This procedure has not been widely adopted and but few clinics have reported significant numbers of cases of early cancer treated in this way The chief contributions to this subject have come from Young² and Colston³ of Baltimore Smith⁴ of Boston and Belt⁵ of Los Angeles Others have attempted the cure of prostatic cancer by total perineal removal but have given us little data concerning their results in any important series of cases This seems to imply that the operation is not effective as a cure of early cancer or that there are few men trained to do the operation Doubtless there are those who regard the operation as too hazardous It is therefore up to those who advocate total perineal prostatectomy to show that this operation may cure the patient is not technically difficult, has a low mortality and is followed by reasonably good functional results

Many regard cancer of the prostate as incurable even in its early stages If this attitude had prevailed for cancer of other parts of the body little progress would have been made in the cure of malignant disease I believe that such pessimism is unwarranted There is evidence which suggests that the results of adequate surgery in early prostatic cancer compare favorably with those for cancer of other organs of the body Some of the most severe critics of total perineal prostatectomy it seems for one reason or another have never attempted the operation At least I know of no reported series of cases in which total prostatectomy has been abandoned because of poor results Such an

* Chief of the Urological Service Massachusetts General Hospital Boston

regular as in a normal articular surface. This highly developed hyaline cartilage gradually merges with vascular fibrous tissue as one passes in one's examination toward the acetabular end of the femoral head.*

The patient was able to work eight hours a day at a very early date. The patient was able to work eight hours a day at a very early date. The patient was able to work eight hours a day at a very early date.

Follow-up: the patient, on April 4, 1941, removed. It is a microscopic cross section taken from the femoral head and it shows the condensation of subchondral bone as well as the newly formed overlying cartilage.

CONCLUDING REMARKS

Mold arthroplasty at this time has a poor reputation and for good reasons. Surgeons have not as yet become fully familiar with the arthroplasty approach, consequently are hampered by inadequate exposure.

The arthroplasty instruments developed during the war became generally available only a year ago. They are indispensable. Considerable experience in their use is necessary before the surgeon learns to take full advantage of them.

The mold does not eliminate the results of faulty surgical workmanship, nor does it bring about satisfactory joint function.

The idea of "mold arthroplasty" is a very recent one.

It is histological, to justify the purpose of recreating a destroyed or damaged structure, is sound.

* From the microscopic description of Dr. G. A. Bennett.

TOTAL PERINEAL PROSTATECTOMY

Technic—We have followed the operative technic of total perineal prostatectomy so carefully worked out and beautifully described by Dr. Hugh Young.¹ We have departed from his original method only in minor particulars. The posterior surface of the prostate is exposed through the perineum and the rectum is well separated from the posterior surface of the prostatic capsule. The urethra is cut across at the apex of the prostate. After the lateral ligaments of the prostate are divided the gland is freed in front beneath the symphysis pubis and the bladder is opened anteriorly at its junction with the prostate. This opening is then enlarged on each side to permit visualization of the trigone and ureteral orifices. The posterior bladder wall is cut through well below the openings of the ureters and the seminal vesicles are exposed. The vesicles and their ampullae are dissected free from the peritoneum and posterior bladder wall. The entire prostate with its capsule, prostatic urethra, bladder neck, and seminal vesicles are removed intact. The cut surfaces of the bladder neck and membranous urethra and the perineal skin are closed.

When we have no evidence that cancer has spread beyond the confines of the prostatic capsule or when we believe that only the lower ends of the seminal vesicles are invaded, we do not regard the operation as technically difficult. It has been performed by our resident staff many times. Mortality and morbidity have been less with us than that of subtotal perineal prostatectomy. There were no hospital deaths in our cases done during the past fifteen years and only three complications of any severity. Postoperative bleeding has been less than after the subtotal operation because of the careful apposition of bleeding surfaces, although bleeding necessitated cystotomy in one patient. Epididymitis developed once after operation and one patient had a small pulmonary infarct from which he recovered. These have been the only complications. During the past two years we have interrupted the superficial femoral veins of most of our patients after total perineal prostatectomy as prophylaxis against pulmonary embolism. We are not certain that this is a necessary precaution following this particular operation but we have had no pulmonary infarcts or fatal emboli among these patients since this measure was adopted. The average stay in the hospital after total prostatectomy was twenty-two days, the shortest having been fourteen days and the longest thirty-nine days. These figures of mortality, postoperative complications, and convalescence compare favorably with those for subtotal prostatectomy.

End Results—Functional results after total prostatectomy have concerned many despite the fact that the operation was to cure cancer. As far as I can determine from the follow-up records of our patients

attitude does not seem fair, particularly if those who advocate the procedure can prove the points previously mentioned. It does seem reasonable that those clinics which report transurethral resections of the prostate by the thousands should at least explore the possibilities of the cure of their early cases of cancer by more radical surgery.

DIAGNOSIS OF PROSTATIC CANCER

Early prostatic cancer produces no symptoms. In the majority of instances, in our experience, this condition has been suspected during a routine physical examination. An exception is found in those cases in which early carcinoma is associated with benign hypertrophy. Then the hypertrophied gland has caused sufficient obstruction to produce symptoms and on examination an area of induration is found present within one of the hypertrophied lobes. The prostate enlarged by benign hypertrophy has much the same consistency as the flexed biceps muscle. If the consistency of the gland is firmer than this or particularly if there are areas of different consistency, whether in the posterior or lateral lobes of the gland malignant change should be suspected. Areas of chronic inflammation or prostatic calculi closely simulate the firmness of cancer and accurate diagnosis often is possible only by histological examination. We have mistaken the hard areas of the tuberculous prostate for cancer.

About one-third of the patients operated upon for early cancer of the prostate were referred to us from other services of the hospital because the gland had felt suspicious during a routine physical examination. When symptoms of early cancer have been detected, it has been our policy to remove a piece for immediate histological examination by frozen section. With a positive diagnosis total perineal prostatectomy is carried out. Such frozen sections were done in about one half of our cases. In the other

not carcinomatous but contained hard areas of inflammatory tissue which felt like cancer. Only once in our series of cases was the frozen section reported cancer where subsequent examination of the entire prostate failed to show malignant change. This is a tribute to our pathology department for the diagnosis of prostatic cancer by frozen section is not an easy one. Needle biopsy when properly performed is not prostatic visible to on before

Of the thirty four total perineal prostatectomies at the Massachusetts General Hospital in the last fifteen years twenty six were performed for proved cancer. Fourteen or 55 per cent of these patients are living and apparently cancer free eight or 30 per cent have died of cancer and four or 15 per cent died from other causes. Some of these patients were operated upon within the last year so the outcome is still uncertain. The results in twenty-one cases in which operation was performed more than one year ago form the basis of Table I.

It is obvious from these figures that as the years go by more patients die of cancer despite total prostatectomy and although 35 per cent of the patients operated upon five years ago are alive and without evidence of this disease some of them will probably eventually die of recurrence or metastases. However the five year results after this operation compare favorably with those of cancer of other parts of the body. How they would compare with a similar group of selected cases unoperated upon or treated by hormonal therapy is unknown since no such comparable series of cases has been yet reported. No other treatment than total prostatectomy appears to offer a chance of cure of early prostatic cancer.

SUMMARY

This is a review of the results of total perineal prostatectomy for early cancer of the prostate over a fifteen year period at the Massachusetts General Hospital. There was no mortality from the operation, complications were few and functional results were reasonably good. Of fourteen patients operated upon over five years ago 35 per cent are living and as far as we can tell free of cancer. I believe this operation should be performed in selected cases of early prostatic cancer provided the patient has a reasonably long life expectancy. There appears to be no other method of treatment that offers any chance of cure to those afflicted with this disease.

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urinary control after operation was "good" in 80 per cent and "poor" in 20 per cent. By "good" it is meant that the patient had perfect control or at the most some slight degree of stress incontinence. Patients with poor control seldom need operation.

During the past fifteen years we have performed total perineal prostatectomy on thirty four patients on our ward service at the Massachusetts General Hospital in an attempt to cure cancer of the prostate. Operations on the private services of the hospital are not included. These cases have been critically analyzed to determine whether mortality, complications, functional and end results justified the procedure. Total cases average little more than two a year. The fact, however, that five of these operations were done in the first five year period and fifteen in the last five years shows that with us the operation has not

TABLE 1

END RESULTS FOLLOWING TOTAL PERINEAL PROSTATECTOMY FOR CANCER IN TWENTY-ONE PATIENTS OPERATED UPON MORE THAN ONE YEAR AGO

Period after Operation	Patients Living Cancer Free	Patients with Recurrence or who Died of Cancer	Patients who Died of Other Causes
3 years (14 cases)	7 (50%)	7 (50%)	2 (15%)
4 (16)	7 (43%)	7 (43%)	2 (14%)
5 (19)	11 (58%)	6 (32%)	2 (10%)
6 (19)	14 (74%)	4 (21%)	1 (5%)
7 (21)	17 (80%)	4 (20%)	0

lost favor. During 1946 eight total perineal prostatectomies were done on our Urological Service.

It is not possible to say how many patients we have cured of cancer by total prostatectomy. The disease varies so much in the length of time it takes to be fatal that five year or even ten year results can be misleading. Again, patients who are subjected to this operation are in

prostatic cancer treated by all means survived a five year period and 75 per cent of untreated cases were dead within twenty-one months. Figures relating to the end results of total prostatectomy should be studied with the knowledge that these patients are all selected cases of early cancer.

dom from foreign body reaction is so important, we never have utilized such an aid. It has been reported furthermore, that in certain types of urinary infections even vitallium tubes are not immune to the precipitation of calcareous material within the lumen.

For the relief of a stenosis at the ureteropelvic junction, a number of plastic procedures were used in this small series of cases. The Foley Y plastic or similar procedure was the most popular. Of these, there were twenty one cases. Not a single one was attempted without accessory drainage tubes of some sort. In sixteen both a ureteral splint and a nephrostomy tube were inserted, in two cases, a nephrostomy tube alone was used, in two a T tube, and in one, a ureteral splint alone. Other methods of repair included one case of a Finney pyloroplasty with both a splint and nephrostomy tube, one case of a Rammstedt operation where no splint or nephrostomy tube was used, and one case of a Gibson pyloroplasty, also accompanied by both a ureteral splint and a nephrostomy tube. There were four additional cases of reimplantation of the ureter into the pelvis where surgeons also used both a splint and a nephrostomy tube.

The cautious beginner, performing his first Foley Y plastic operation will enjoy a great sense of security by using both a ureteral splint and a nephrostomy tube after the fashion of so many of our staff. It was our custom to insert a number 8-10 or 12 F soft rubber urethral catheter through the renal cortex or through an opening on the posterior aspect of the renal pelvis and thence through our line of anastomosis and on down the ureter for a distance of six or eight centimeters. A second catheter usually a whistle tip perineal tube size 24 or 26 F then was brought through the same opening in the renal cortex beside the ureteral splint into the renal pelvis to serve as a nephrostomy tube. Theoretically this nephrostomy tube facilitated healing of the plastic operation by putting the pelvis at complete rest and later served to ease the strain on the suture line after the ureteral splint was removed.

The ureteral splint is left in place anywhere from two to twenty days the average being 9.6 days. The optimum time for the removal of this splint is determined by the intuition of the surgeon. Experience has shown that at the end of about ten days primary healing of the suture line will have taken place unless severe sepsis, extravasation of urine or extensive bleeding has intervened. In none of the cases were periodic postoperative urograms made before the removal of the splint as suggested by Henline and Menning² to demonstrate complete healing of our suture line.

Our nephrostomy tubes were left in place for about fifteen days. The general indications for the removal of this supplementary tube include a normal temperature, absence of urinary leakage around the tube, absence of severe infection of the urine on the affected side and the

URETERAL SPLINTS

SYLVESTER B. KELLEY, M.D.*

STIMULATED by a recent article of Dr. Clyde Deming¹ in which he pointed out the potential dangers from the use of drainage tubes and splints after plastic procedures on the kidney pelvis and upper ureter I have reviewed the records of the last forty three patients operated upon at the Massachusetts General Hospital for hydronephrosis secondary to ureteral obstruction in an effort to determine the common practice of members of our staff and to evaluate the results of the more common operative procedures which involve the use of ureteral splints. Inadequate follow up notes on many of the patients and the wide range in the skill of the sixteen different operators whose work I have gone over eliminate any statistical value of such a report but I have gained a number of impressions which may be of some assistance to others interested in this specialty. Inasmuch as postoperative infection of the urinary tract is of major consideration under these circumstances I have restricted my study to those cases done during the past seven years when the more effective antibiotic agents have been available.

In the multitude of different types of disease encountered in the upper urinary tract there of course can be no hard and fast rule governing the use of a ureteral splint. Under certain circumstances it is

skill and infinite patience to produce a water tight suture line at a ureteropelvic junction obviously no splint will be necessary. Few of us possess such ability but there is no reason why it cannot be developed. By the majority a splint is looked upon as a precautionary measure against the extravasation of urine in case the suture line gives

mucosa of the new ureter

Since giving up the use of the irritating woven silk ureteral catheters for splints some years ago we have employed soft rubber catheters for this purpose. They have worked fairly satisfactorily. Although vitallium tubes have some theoretical advantages in these situations where free-

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Fig 405—Comparison of results of two different procedures for correction of ureteropelvic obstruction in a 44 year old woman with bilateral hydronephrosis. *Top*, The preoperative condition. *Center*, The condition in July, 1943 sixteen months after a Rammstedt operation on the right ureteropelvic junction. *Bottom*, The condition in October, 1946 nineteen months after a Foley Y plastic operation on left side.

prompt passage of dye from the bladder after it was injected through the nephrostomy tube into the newly created renal pelvis

In cases where it seemed unwise to drain the kidney through a nephrostomy, two of our men had satisfactory results with simply a T tube to splint the ureter following a plastic operation at the ureteropelvic junction. The stank of the tube is brought out through an opening in the ureter below the line of anastomosis. One arm of the tube extends upward through the suture line into the kidney pelvis and the other arm extends for a short distance down the ureter. This is left in place for the same time as the other types of ureteral splint—about ten days. This arrangement has its merits in that it spares the kidney from the trauma and likelihood of infection associated with a nephrostomy. Its disadvantage of course besides its irritating influence on the suture line is that once it is removed nothing can be done in case of leakage through the anastomosis. We no longer have in reserve a nephrostomy to carry us over the temporary embarrassment of a postoperative pyonephrosis. But with our constantly improving technic and means of combating infection we should not anticipate such complications and should feel free to adopt this logical splinting device if we feel the need of additional help.

would seem that no calamities were experienced by any of the twenty one patients. There is no record of a secondary nephrectomy or of a persistent sinus at the time of their discharge from the hospital. Five patients were lost after their discharge. Seven showed little or no improvement in the x ray appearance of the operated kidney by intra-

the operated kidney with available urinary antiseptics we were able to overcome this complication. Another striking discovery was that the one case where no ureteral splint was used, and where the pelvis presumably was put at rest with a nephrostomy tube after the plastic procedure at the ureteropelvic junction showed no pus cells postoperatively. Despite the small number of cases in this series I



Fig. 406—Results of pyloroplasty after the method of Kuster Lubasch in a woman of 31. Top: The preoperative condition of the left kidney. Center, Three weeks postoperatively. Bottom: Three months later.

believe we have a rather striking bit of evidence that persistent infection in the kidney does interfere with a satisfactory operative result on the pelvic outlet

Figure 405 enables one to compare the results of two different procedures for the correction of ureteropelvic obstruction with bilateral hydronephrosis. In the Rammstedt operation no splint was used, in the Foley Y pyeloplasty, a ureteral splint and nephrostomy tube were left in place for nine and twenty days respectively. In October 1948, sediment from the right kidney contained two white blood cells per high power field, that from the left side showed three white blood cells per high power field. On the basis of this single case one might infer that a Foley Y pyeloplasty was preferable to the more conservative Rammstedt procedure.

In this collection of patients there were four cases where the stenosed ureteropelvic junction was completely excised and the ureter reimplanted in the pelvic wall. The two men who did these operations used both a ureteral splint and a nephrostomy tube in all four cases. Their follow up notes are very brief. One patient was lost, one had no improvement by x ray, one showed slight improvement by x ray and one showed marked improvement. Pus cells were present in the two cases with reported urinalyses. Suffice it to say that all four patients left the hospital after their plastic operations with both kidneys healed wounds and relief from their original complaints.

Figure 406 illustrates the improvement in a woman whose severe ureteropelvic stenosis was relieved by a pyeloplasty after the method of Kuster Lubasch. Here, the stenosed pelvic outlet together with the upper ureter were excised and the upper portion of the ureter then

the obstruction

To this group of plastic operations at the kidney outlet I have added

were left in place for anywhere between eleven and eighteen days. Eight cases had no splints inserted and in one case a nephrostomy tube was used to drain the renal pelvis after the ureter had been freed. Under these circumstances where I am unable to visualize the surgeon's conception of "dense fibrous adhesions" or a "mass of plastic exudate," it is rather difficult to interpret the results of ureteral splinting. I am obliged, therefore, to base my impressions upon those cases with which I am personally acquainted.

When the ureteral obstruction is due to angulation by a few light fibrous bands, and uncomplicated by a ureteral stricture, the use of a



Fig 407—Results of "intubated ureterotomy" in elongated stricture of ureter without extensive ureteral reaction in a young man of 47 *Top* The preoperative condition *Bottom* Twelve months after operation

ureteral splint has little influence upon the final outcome. In fact, the better results among these patients seem to have been in those instances where the ureter was not opened at all and where no splint was used. The poor results on the other hand, were in those situations where the ureter was buried in a dense scar. Even when splints were employed for periods of fifteen days under these circumstances, the ureter shortly afterward became stenosed with a return of the hydronephrosis and urinary infection. When, therefore, the ureter is bound down firmly in a plastic exudate, I believe that the mere lysis of adhesions and the insertion of a splint are futile gestures. It is necessary also to dissect out the surrounding scar tissue if one expects to prevent a recurrence of the ureteral narrowing.

In my opinion the elongated strictures of the ureter without extensive periureteral reaction come under a different category. These respond well to the "intubated ureterotomy" procedure described by David M. Davis³ in which the strictured portion of the ureter is simply incised longitudinally and then drawn part way around a ureteral splint. No attempt is made to reapproximate the edges of the ureter. The splint in such cases serves merely as a mold around which the ureteral mucosa regenerates to form the ureteral lumen. Figure 407 illustrates an outstanding case of this kind operated upon by one of our staff. The patient had a relatively clean urine to start with. Here we merely incised a long structure of the left ureter and used a number 10 F rubber catheter as a splint. For supplementary drainage a medium sized nephrostomy tube was inserted. The splint was left in place fifteen days and the nephrostomy tube for eighteen days. Twelve months after operation the urinary sediment contained only a "rare white blood cell." The patient now is symptom free.

The work of Crabtree and Kontoff⁴ concerning the microscopic appearance of nontuberculous strictures explains why simple dilatation of the stenosed portion of a ureter is quite inadequate. These gentlemen found that in the region of the stenosis there usually is very little smooth muscle; the ureteral wall consists mainly of dense fibrous tissue and the epithelial lining in the same region tends to be desquamated with only a few shreds attached to the surface. In most cases then ureteral dilatation alone merely serves to aggravate the fibrous tissue reaction and actually to make the stricture worse.

In attempting to appraise one's efforts to improve renal function by a plastic procedure on the ureter, with or without a ureteral splint, one should realize that the x-ray appearance of the kidney pelvis alone is not indicative of the result of the operation. Very frequently in cases of long-standing infection and obstruction the walls of the renal pelvis have been so overstretched and then fixed by fibrous changes within the pelvic walls and in the perirenal tissues that they never will shrink down after the obstructive factor has been removed. The

ODONTOGENIC INFECTIONS OF THE JAWS AND ASSOCIATED SOFT TISSUES AND THEIR TREATMENT WITH THE AID OF ANTIBIOTICS

KURT H. THOMA, D M D *

THE sepsis of fractures compounded into the mouth, osteomyelitis, secondary neck infections and facial cellulitis are generally of odontogenic origin, caused by endemic bacteria derived from the oral cavity and the teeth. They frequently represent an extension from a latent dental focus that has become active or aggravated by trauma such as tooth extraction, or precipitated by lowered resistance caused by fatigue or a debilitating general disease.

The advent of chemotherapy and especially the employment of antibiotics to prevent and combat infection has considerably altered the treatment of infections about the jaws. In some instances, these new agents are so effective that surgical interference is eliminated, while in others they make possible earlier surgical measures with greater safety to the patient and a more rapid convalescence. In most instances, however, the use of antibiotics combined with carefully planned and adequate surgery gives the best results.

ANTIBIOTIC THERAPY

In considering therapeutic measures, the identification of the morbid organisms is as important as the finding of the immediate cause of the disease. A thorough bacteriologic study should be made in all cases because of the selective effect of the antibiotic drugs. If the infected tooth is still present, a culture may be made when it is ex-

of course would simply indicate that the organisms are penicillin-sensitive. Both aerobic and anaerobic cultures are essential, and a smear should be examined for Vincent's organisms, because of the difficulty in growing the fusospirochetel organisms in vitro.

The bacteria found most commonly in jaw and neck infections are the alpha and beta hemolytic streptococci, nonhemolytic streptococci, fusiform bacteria, and clostridia. Jaw infections are usually caused by a mixture of these organisms.

Bacillus coli, bacterioids, *ramosus*, *perfringens*, and other gram negative bacilli and clostridia. Many of the latter are known to be

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postoperative pyelogram in such a case would be discouraging. In such cases, therefore, we judge the results of our work not by the disappearance of the hydronephrosis but by the improvement in kidney function and the subsidence of infection.

Weighing the results of our plastic operations in the same light as those at the ureteropelvic junction, with those urologists who use splints in such procedures. Many of our results at the Massachusetts General Hospital have been good, but I believe they would have been better had we avoided the use of needless foreign bodies rubbing the suture line of our anastomosis. Avoidance of infection seems to be one of the main aims.

By limiting the use of various catheters and splints, we should create an environment favorable to primary healing of our suture lines and to a successful outcome of our efforts. In the case of an intubated ureterotomy, a ureteral splint is legitimate, but its use elsewhere seems contrary to the principles of good surgery.

SUMMARY

1 Forty three cases of ureteroplasty have been reviewed with particular reference to the use of ureteral splints.

2 With intubated ureterotomies, ureteral splints are legitimate adjuncts, in most other types of plastic operations at the ureteropelvic junction ureteral splints aggravate infection of the urinary tract.

3 Urinary infection interferes with primary healing of our anastomosis.

4 With meticulous surgical technique in ureteroplasties, ureteral splints should not be necessary for successful results.

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recovery

Cellulitis and abscesses of the fascial spaces may be caused by both deciduous and permanent teeth Submaxillary, submental, sublingual

Fig 408

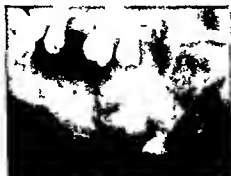


Fig 409



Fig 408—Osteomyelitis of the mandible due to furunculosis

Fig 409—After saucerization and sequestrectomy a rubber catheter is inserted to the bone and the incision closed by suture

parapharyngeal and infratemporal abscesses may develop. In some cases satisfactory results may be obtained by conservative treatment in order to retain incisors and canines, but in many cases extraction is indicated as soon as possible to remove the cause, and in some cases to establish drainage. Even in acute suppurative cases there is no great danger of complications from this procedure with the prophylactic use of penicillin.

penicillin resistant, but are affected by streptomycin. Sensitivity tests

CASE I—J B (MCH No 551549) a 54 year old man, entered because of chronic osteomyelitis of the mandible of one year's duration. Two infected teeth had been extracted and penicillin treatment was used but a draining sinus remained. The x ray showed osteomyelitis which caused intermittent swelling and suppuration. Bacterial examination revealed a pure culture of *Escherichia coli*. The patient was treated with streptomycin, 0.2 gm every four hours and penicillin, 24 000 units every three hours. A saucerization and sequestrectomy of the involved section of the mandible was performed. This was followed by topical instillation of penicillin through a catheter to the bone cavity, and continuation of the intramuscular therapy. The wound was completely healed two and one half weeks later.

Comment—Because of the presence of penicillin resistant organisms, previous treatment was unsuccessful until streptomycin was instituted.

CASE II—E B (MCH No 551550)

purulent discharge. Incision and drainage was performed on January 8.

Anaerobic cultures yielded *Clostridium sporogenes*. The smear showed an abundance of bacilli.

mycosis

streptomy

gations of

on Janua

relieved. Three weeks later all fistulas had healed.

Comment—In spite of both penicillin and streptomycin treatment a mixed anaerobic infection of the face did not respond until chlorophyll raised the local tissue resistance to infection.

SURGICAL TREATMENT

Surgical procedures should be carefully planned. The right method must be applied at the right time.

The Removal of the Cause—In odontogenic infections the removal of the causative tooth is of primary importance. In most instances the infection spreads through the pulp canal of a carious tooth or root. Periodontal infection and pericoronal infection of a partly erupted impacted tooth are also etiologic factors. If the cause is not removed recovery is delayed and complications may set in as illustrated in the following case.

CASE III—O D (MCH No 29358) a 31 year old woman had been treated for a submental phlegmon by chemotherapy and incision and drainage. She re-

gery. Many patients do not present themselves for treatment early enough, however, and require elimination of accumulated pus and excision of dead bone.

In *fascial abscesses* the pus may be aspirated by means of a syringe, and the immediate injection of penicillin in dilution of 1000 units per

Fig 410.



Fig 411.

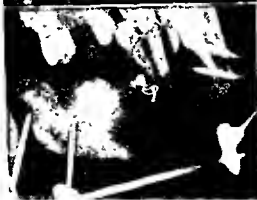


Fig 410—Compound, comminuted fracture of the mandible complicated by a cyst and submandibular cellulitis. X-ray taken after the tube was inserted into the cyst for local instillation of penicillin.

Fig 411—Fracture reduced and immobilized by skeletal fixation with accessory wire suture. Note: The pins on the right do not extend into the cyst, the x-ray appearance is due to angulation when the exposure was made. X-ray was taken eight weeks after reduction showing healing of bone.

cubic centimeter may be beneficial. . . .
tion of the pus, followed by instillation
inserted into the abscess cavity (Fig
414). The advantage of this method over the aspiration technic is
that penicillin or streptomycin can be instilled every three or four

Osteomyelitis of the jaw is generally of dental origin, hematogenous infection and infection from furunculosis is rare. The tooth causing the acute infection is usually sore, but in widespread extension many teeth may be secondarily involved. Adequate dental radiographs are essential. In most cases, extraction is indicated as soon as a good penicillin level has been obtained. A case in which the osteomyelitis was caused by furunculosis was seen recently.

CASE IV—JH (MGH No 585448), a 36 year old man presented clinical and x ray evidence of osteomyelitis. A furuncle had formed in the subauricular region six months ago and resid. . . . jaw developed two weeks before . . . tion associated with the teeth. . . . second molar later became painful. . . . therapy was started. The symptoms . . . worse, and a lateral jaw pain showed extensive osteomyelitis (Fig 408). A radical saucerization and sequestrectomy was performed and a rubber catheter inserted for local instillation of penicillin (Fig 409). The culture at operation grew out *Micrococcus catarrhalis* and *Staphylococcus albus*. Recovery was uneventful.

Comment—The instillation of penicillin via an inlying catheter assures concentration of the drug not possible by the intramuscular route.

Septic fractures often are due to the involvement of a tooth. Infection may penetrate from the gingival margin along the fracture, causing an abscess of the adjacent fascial spaces and result in osteomyelitis with extensive loss of bone. It is a good rule to extract teeth in the fracture line even though they may be valuable for intermaxillary fixation. Today there are several good methods available for the fixation of jaw segments which have been made edentulous by such extractions. The following case illustrates the formation of a submaxillary abscess from a fracture along a tooth.

CASE V—JH (MGH No 471641) a 37 . . .

penicillin. Sepsis ceased and bone repair followed uneventfully.

Comment—The tooth in the line of fracture was the source of sepsis and bony union was prevented while the tooth was retained.

The Elimination of Pus and Necrotic Tissue.—In some cases the use of antibiotics may result in resolution without operative interference, particularly if such treatment is instituted before pus has formed and before bone necrosis has set in. Fascial abscesses which previously had to be incised and drained, and cases of acute osteomyelitis which previously went on to sequestration may thus be cured without sur-

Fig 412



Fig 413



Fig 412 -Submaxillary abscess with multiple fistulas due to septic fracture

Fig 413 -X ray of patient shown in Figure 412 taken during operation with the intratracheal tube in place. It shows teeth involved in the fracture line with osteomyelitis and formation of sequestrum



hours to supplement the parenteral administration. Similar treatment may be used in acute infection of odontogenic cysts,

cular injections of penicillin were continued and supplemented with local installations. The culture revealed the presence of *Staphylococcus albus*. After the acute infection had subsided, the cyst was enucleated, the cavity filled with fibrin foam, closed by suture, and skeletal jaw fixation applied. Five days later the patient was discharged. After eight weeks the x ray showed satisfactory bone healing (Fig. 411), so that the appliance could be removed. When tested, it was found that the jaw had healed satisfactorily and all signs of infection subsided.

In fractures complicated by osteomyelitis a sequestrectomy usually is necessary, and best accomplished from an extraoral approach. If the bone loss is not too great, union may be expected if the jaw is properly immobilized. I have had excellent results with skeletal fixation, using pins in the anterior fragment far away from the infection, and my peripheral bone clamp on the posterior fragment in the infected region. Since its use does not involve drilling into the bone, there is no danger of spreading the infection.

CASE VII—S. McK. (MCH No. 533145) a 46 year old woman had been struck on the jaw six weeks previously, and contracted a fracture. She had received medical care which included penicillin therapy for four days. She had a submaxillary swelling and multiple draining fistulas (Fig. 412). X ray examination revealed a fracture complicated by osteomyelitis. A molar extended into the fracture line (Fig. 413). The temperature was 99.4° F., and the white cell count 11,000. She received 32,000 units of penicillin every three hours and two days

perforations were performed, a rubber catheter inserted and the fracture ag-

In osteomyelitis the removal of necrotic bone, when completely sequestered, may be a simple procedure, especially if an intraoral approach is possible. In other instances, the sequestrum may be eroded or inaccessible, and an extraoral approach is preferable. The bone is decorticated to expose the infected channels so that all necrosis can be removed. Saucerization should be carried out to eliminate

Fig. 414—After sequestrectomy the fracture was immobilized by means of peripheral pins inserted into the anterior the instilla

cised (Fig 416) He was given local therapy through a rubber catheter in addition to the intramuscular injections The wound healed promptly, and ten days after the operation he was discharged completely relieved He is to return after six months for a bone graft to restore the continuity of the jaw

POSTOPERATIVE TREATMENT

The after care is important in all jaw infections Treatment with the specific antibiotic should be continued until all signs of infection have subsided In most oral cases, the patient receives a liquid diet high in protein, calories and vitamin content Infection depletes the vitamin stores in the body, and patients with severe or prolonged dental infection become easily dehydrated because of the difficulty or

union of dental patients afflicted with chronic suppuration and help to overcome the infection The oral hygiene often neglected, is of prime importance to prevent secondary infection and to minimize sepsis

SUMMARY

Odontogenic infections of the jaws and associated soft tissues are mixed bacterial invasions by both penicillin sensitive and resistant organisms Antibiotic therapy is effective only when the etiologic organisms are carefully identified by both culture and smear The local instillation of the antibiotic agent to the septic zone via an inlying proved most effective of antibiotics should be surgery

Oral tissues have an extremely high resistance to infection, yet when invaded present serious problems with solemn complications Careful preoperative planning and meticulous postoperative care are necessary to prevent poor cosmetic and functional end results

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overhanging margins. The wound is then closed in layers either completely or around a rubber catheter inserted to the area for the instillation of local penicillin or streptomycin as already recommended. Case I and IV were treated in this manner.



Fig 415



Fig 416

Fig 415—X ray showing osteomyelitis of the mandible with pathologic fracture.
 Fig 416—Segment of necrotic bone excised and a rubber catheter inserted for the local instillation of penicillin.

In chronic cases of osteomyelitis which have resisted treatment, a completely necrotic segment of the jaw may have to be excised. The continuity of the bone is restored later by a bone graft. The following case serves as an illustration.

ologic fracture resulted in the disclosure of *Bacillus coli* and *Staphylococcus albus*. A smear showed Vincent's spirilla and fusiform bacilli. He was hospitalized again and given both penicillin and streptomycin. After two days the diseased segment of the mandible was completely ex-

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PHILADELPHIA NUMBER

SYMPOSIUM ON MODERN TRENDS IN SURGERY

FOREWORD

This number departs from the earlier pattern of the *Surgical Clinics of North America*, yet every paragraph is based upon actual clinical experience on the part of the authors.

In making up this number of the Clinics the editors also departed from the usual pattern. Instead of trying to hold a symposium on one subject or from one hospital or from a single medical school, they decided to produce a request number. Each article was requested by some subscriber and the function of the guest editor was simplified by having only to obtain the best Philadelphia author for that particular subject.

These authors represent all the medical schools and a great many of the hospitals of Philadelphia. Each article has been well prepared.

Were your guest editor to contemplate a surgical textbook he would be happy to have the authors of this number of the Clinics as the contributors for such a work.

WILLIAM BATES, M.D.
Consulting Editor

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THE SURGICAL CLINICS of NORTH AMERICA

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FOREWORD

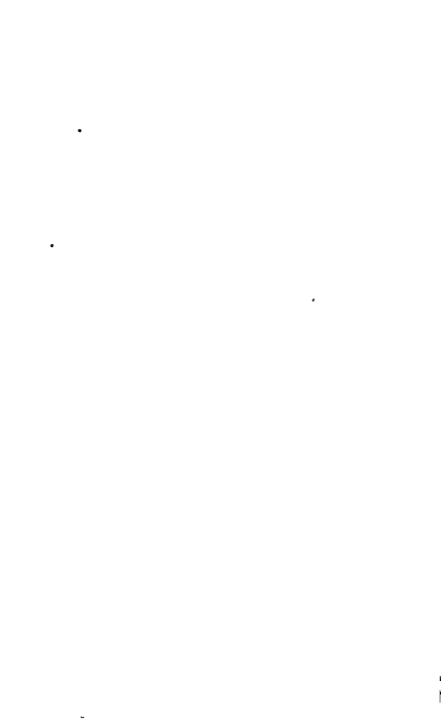
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WILLIAM BATES M D
Consulting Editor



TECHNIC OF PAIN CONTROL

BERNARD D JUDOVICH, M D * AND
WILLIAM BATES, M D †

THE subject of pain control is encountered in almost every specialty of medical science. It is, therefore, impossible to discuss adequately many aspects of this important problem. We have selected certain painful syndromes. These, while common, often present problems in diagnosis and therapy. Most of these painful syndromes are somatic in origin. None of them is to be regarded as a specific disease entity. The terms "sciatic neuralgia," "intercostal neuralgia" and the like should be regarded only as names which denote specific areas or pathways which are painful. Actually, these conditions may be caused by any form of irritation due to disease, trauma, infection, mechanical disturbances, metabolic abnormalities, or exposure to physical elements.

In every case, a thorough attempt must be made to arrive at a diagnosis, because, ultimately, the procedures adopted and the end results obtained are dependent upon the nature and the location of the lesion. We shall, therefore, devote considerable space to principles which we have employed as guides in localizing the origin of pain.

The problem of controlling pain demands, at times, the cooperation of the neurologist, surgeon, neurosurgeon and orthopedist as well as the internist. Application of all known methods and procedures may sometimes result in failure. Fortunately, most patients do not have a serious organic lesion as the basis of their complaints, and it is possible in the majority of instances to provide relief of pain. Exhaustive studies in many of these patients fail to divulge a definite cause.

Our approach to the technique of somatic pain control hinges largely upon the pattern of tenderness which is associated with the pain rather than by focusing attention only upon the area of the patient's complaint. In this manner the origin of the pain can better be localized to definite areas and levels.

Accordingly, upon the basis of tenderness, a clinical concept has been formulated which evolves out of the presence of tenderness and its patterns. While it may leave much to be desired, and exceptions are sometimes encountered, it is a satisfactory concept for practical application.

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We have found that the problem is best approached by dividing somatic pain into three groups: local, transmitted and reflex.

Local Pain. The pain or pain and tenderness remains confined to the region of involvement without radiation. Examples are bursitis, tendinitis and arthritis.

Transmitted Pain. The pain is carried along the course of a nerve with either a segmental or peripheral skin pattern. This implies root or trunk irritation in the course of the nerve either by intrinsic nerve changes or by contiguous structures along its course. The pattern of distribution is determined by eliciting tenderness. Examples of this type of pain are chest and abdominal wall neuralgias, sciatic pain due to root, trunk or peripheral branch irritation, occipital neuralgia and brachial plexus neuralgia. Sensory or motor disturbances such as anesthesia, hypalgesia, trophic changes, motor involvement and diminution or absence of reflexes may or may not be present. In exceptional cases pain of the transmitted type may have no pattern of tenderness.

Reflex Pain. Reflex pain is pain which is referred from an irritated somatic structure to a distant region within the same segments. An example of this type is pain which is referred from the hip joint tendons to the lower leg. The region of referred pain is not associated with pattern tenderness. Reflex pain may also be referred from muscles and other local structures to distant regions of the same dermatome or contiguous levels with absence of pattern tenderness in the zone of reference. Reflexes are not diminished or absent. Motor weakness and atrophy do not develop. In other words, the nerve pathways are merely acting as carriers of the pain impulse without the nerve actually being involved in the irritative or degenerative process.

In occasional cases the region of referred reflex pain may be associated with a markedly sensitive zone which has no recognizable pattern. This type of pain obviously cannot be regarded as transmitted.

contiguous levels and the resultant irritation is expressed in the periphery by tenderness and pain which are probably vascular in origin.

Based upon the objective findings then, the patient's complaint can be classified into one of these groups. This determines the areas to which study and therapy are to be directed. In the local type there is the least difficulty, the studies and therapy being applied to the

and all skeletal structures receiving nerve supply from this level are carefully examined for a local lesion which produces the radiation. Reflex reference of this type may also have its origin from visceral sources.

There are two types of skin tenderness the superficial and the deep. In the superficial type, there is tenderness to pinch when a fold of skin and fat is compressed between the fingers. There is also hyperalgesia of the skin demonstrable by pin-prick or pin-stroke. When the skin is pinched in the superficially tender type, a definite thickness

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The second type, which is characterized by poking or pressing the skin firmly against a muscle or bony structure, and not by pinching or pin-stroke. When the skin is picked up between the fingers and



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Segmental Neuralgia in Painful Syndromes (F. A. Davis Co.)

pinched, there is little or no subcutaneous fat in the skin fold, as shown in Figure 418.

This type may also be defined as pressure tenderness. We have demonstrated that the deep tenderness is not caused by irritation of underlying muscles.¹²

Approximately 10 to 15 per cent of patients with segmental neuralgia show this deep skin tenderness. The tenderness may be in the deeper skin layers or in the superficial fascia, or perhaps poking initiates a different type of stimulation. In this group, because the patient presents no superficial signs of tenderness, its presence may be overlooked.

Localization of the patient's pain may be facilitated by consideration of the following (a) location of the pain, (b) duration of the pain, (c) visceral disturbances associated with the pain, (d) character of the pain, (e) time relation to the onset of the pain, (f) frequency of the pain, (g) constant, recurrent or periodic pain.

When examining the patient, localization of the pain is aided by (a) a search for signs of motor or skin sensory disturbances, (b) the ability to reproduce or intensify the pain by local stimulation or



Fig. 418—Testing the abdominal wall for skin and fat tenderness. Note the close proximity of the thumb and forefinger which means that little or no fat layer is present.

by motion of certain skeletal structures, (c) eliciting the pattern and location of tenderness which accompanies the spontaneous pain, (d) gnostic and therapeutic examination and treatment of the tender points, (e) the use of drugs which interrupt the pain cycle, and (f) the use of drugs to control the drug treatment.

dorsal root section sympathectomy, intraspinal injection (alcohol ammonium sulfate), injection of nerves paravertebrally (spinal nerve and sympathetic ganglia), peripheral nerve block, local injection somatic structures of a traumatic nature or a trigger point area.

In general it may be said that chordotomy, posterior root section and sympathectomy are measures which should be employed only after the other measures have failed to provide relief. Posterior root section is useful only if the pain remains localized to one or a few segments. Chordotomy is employed in widespread intractable pain, pain which will eventually spread, as in malignancy.

In our experience, local infiltration and paravertebral nerve block have proved to be most effective of all the conservative procedures. Nerve block requires more accurate localization of the source of pain than other methods of conservative therapy. This is accomplished by interpreting the skin sensory segments or patterns which are present and with the aid of bony landmarks and paravertebral tender points the nerve trunks which supply the tender area can be located. In discussing the painful syndromes space does not permit full description of the clinical features. Methods of relieving pain are stressed and a diagnosis is mentioned when it pertains to this purpose.

SCALENUS ANTICUS SYNDROME

This condition is one of the most common causes of pain in the shoulder girdle and upper extremity. There are two types of anterior scalene syndrome: primary and secondary. A *primary* scalene syndrome is one in which symptoms originate in and are due to an intrinsic disturbance of the anterior scalene muscle, either spasm or hypertrophy usually due to trauma. A *secondary* scalene syndrome is one in which symptoms are due to reflex spasm of the anterior scalene muscle caused by irritation of structures in the shoulder girdle, or disturbances of segments which innervate these structures. In scalene syndromes there is tenderness to pressure over the insertion of the scalene muscle above the clavicle. This is a reliable sign but it does not differentiate primary from secondary types. Pressure at this point will cause intensification of symptoms and reproduce the pain which the patient complains of. With a primary scalene syndrome, there is no limitation of motion of the shoulder joint. If motion of the shoulder joint is limited we know at once that this is not a primary scalene syndrome. The differential diagnosis between a primary and a secondary scalene syndrome in the final analysis rests upon the procaine infiltration test. Complete even though temporary relief of pain within a three minute period is interpreted as a primary scalene syndrome. Partial relief within a period of three minutes means that the pain is due to a secondary scalene syndrome. Failure to obtain relief indicates the absence of a scalene syndrome, provided that the muscle was properly

infiltrated. The test is not reliable if accompanied by a Horner's syndrome or if anesthesia develops in any part of the brachial plexus. Either of these phenomena may stop pain which is not due to a scalene syndrome. Should this occur, repeat the test.

Secondary scalene syndromes cause diffuse pain and tenderness to be superimposed upon the primary lesion, so that the clinical picture is confused when a diagnosis is attempted on the basis of delineating tender zones. Infiltrating the scalene muscle erases these overlapping signs within three minutes so that the primary lesion becomes more apparent.

It has been simplified that injecting 15 or 2 cc of procaine into the muscle will usually stop the pain of a primary scalene syndrome without anesthetizing sympathetic or brachial plexus fibers.

Among the lesions which may cause secondary scalene spasm are intraspinal space-taking and inflammatory lesions of the cervical spine, radiculitis of the third to seventh cervical nerve roots, herniated or degenerated cervical disks, malignancy of the cervical spine, primary growths or metastases of the cervical spine, disease, trauma or inflammation in or around the shoulder joint, disease, trauma or inflammation of skeletal structures supplied by the third to seventh cervical segments, the central diaphragm and the pericardium and Parkinson's disease.

A scalene syndrome may cause pain in the chest and arm which stimulates coronary disease.¹² Indeed it may be responsible for electrocardiographic changes which will arouse further suspicion of a coronary accident.¹³ On the other hand we have reported scalene syndromes which follow myocardial infarction.¹⁴ In these cases, we

sultant pericarditis irritant

This in turn causes an intrasegmental reflex reference of pain in the sensory distribution of the third, fourth and fifth cervical segments causing pain which is referred to the neck, subclavicular region, shoulder girdle and proximal half of the upper arm. If the stimuli are adequate a spasm of the anterior scalene muscle develops as a sensory motor reflex. As a result, additional symptoms develop which involve the entire upper extremity. The pathway is purely somatic as contrasted to the post coronary reflex dystrophies of the sympathetic type which affect the shoulder and hand.

This reflex mechanism from a pericarditis via the phrenic nerve which initiates a secondary scalene syndrome is no different from the reflex scalene syndrome which is produced by a bursitis or tendinitis of the shoulder. Both are referred by the spinal nerves to the segments

of the fourth and fifth cervical nerves (phrenic, third cervical, in addition) and both are initiated by sensory impulses which originate in the structures which are supplied by somatic nerves. We feel that this mechanism may explain the occurrence of anginoid pain which is caused by diaphragmatic hernia and other lesions in this vicinity. The phrenic nerves also have intra abdominal branches which pass to the celiac plexus and suprarenal glands. The right nerve sends branches to the falciform and coronary ligaments of the liver and the inferior vena cava. Branches of both phrenic nerves have been described as going to the peritoneum.

Using faradic current, we stimulated the phrenic nerve close to the diaphragm in a dog. At each contact the neck muscles were thrown into a reflex spasm, yet there are no structures in the neck directly supplied by the phrenic nerve. The phrenic nerve therefore, is a pathway, which could explain the *anginoid symptoms which accompany upper abdominal lesions*. Pain could be referred from this point to the central diaphragm, the precordium, as well as to the shoulder girdle and proximal half of the upper arm and finally, by a reflex scalene spasm could cause overlapping of pain to the chest, shoulder and entire upper extremity.

In our experience, the incidence of secondary scalene syndromes far outnumbers that of the primary type. We believe that failure to distinguish between the primary and secondary types, and their causes, and ignoring brachial plexus and sympathetic anesthesia following diagnostic infiltration are the main reasons patients still complain of their original pain after the anterior scalene muscle has been transected.

The treatment of a primary scalene syndrome is repeated procaine infiltration. If after four treatments sustained relief is not obtained the muscle should be transected. If progress is made, injections may be continued. If progress becomes stationary, the amount of residual pain should be the guide for surgery.

In secondary
Infiltration of the
made for the upper
cervical spine upper dorsal spine scapula chest and shoulder joint

SIMULATION OF ANTERIOR SCALENE SYNDROME

Narrowing of the costoclavicular space which compresses the subclavian vessels produces symptoms identical to those of a scalene syndrome. Injection of the muscle gives no relief. Resection of the portion of the first rib underlying the subclavian vessels may be necessary to effect a cure.¹³

Pain in the elbow region due to an external epicondylitis and extensor tendinitis is often associated with subjective numbness and tingling in the fingers. The epicondyle is tender to pressure and roll

ing the tendons under the examining finger often causes reflex paresis to the hand. This pain may be aggravated by asking the patient to grasp a large object with all the fingertips and squeeze hard. This causes pain in the elbow region and extensor tendons below. Infiltration of the acute tender points at and below the epicondyle with 3 cc of 2 per cent procaine every fourth day usually causes quiescence of symptoms.

Pain in the shoulder girdle and lower arm is often due to reflex radiation which has its origin in the infraspinatus fossa. The trigger point is about 3.5 cm. below the midspine of the scapula. Thus pressure and rolling the finger reproduces and intensifies the painful radiation to the shoulder and arm. This point should not be labeled as a fibrotic deposit as it is constant in its location. We believe that it is the branch of the suprascapular nerve which supplies the infraspinatus muscle, possibly a Vallieux point. This point is located and infiltrated with procaine by passing the needle down until contact is made with the scapula. Three cubic centimeters are injected. The needle is withdrawn slightly and another 3 to 5 cc. are injected. This syndrome may exist alone, or, more commonly, is found in conjunction with other shoulder lesions.

Brachialgia statica parasthetica is a condition due to a mechanical irritation of the lower cord of the brachial plexus which causes numbness and tingling in one or both hands.²⁶ There is usually no pain. This syndrome may simulate a scalene syndrome.

Pathology which causes inflammation or compression of the subclavian vessels or the brachial plexus or any lesions of the shoulder girdle including the cervical and upper dorsal spine may produce

PAIN IN THE CHEST WALL AND ABDOMINAL WALL

Pain in the chest wall and abdominal wall as a result of segmental neuralgia is a phenomenon frequently encountered. Neuralgia may simulate pain arising from any visceral organ depending upon the intensity, character and location of the spontaneous pain. In our experience, pain impulses from viscera do not give rise to tender dermatomes.

In coronary disease it has been claimed by some investigators that anesthetization of the somatic component of the referred pain will permanently relieve the pain even in acute myocardial infarction if the proper trigger areas are found. We have not been able to duplicate this work nor do we subscribe to the theories which are used to support it. Lewis was not able to modify the pain of angina pectoris by similar methods. More recently Mandl¹⁷ states that he tried the method in a few cases in which hypersensitive zones had been deter-

mined, but saw almost nothing but failures. He goes on to say that they were unable to produce an effect which persisted for more than a few hours and always had to resort to paravertebral blocking of the sympathetics.

Danielopolu,⁵ Jonnesco,¹⁰ Lenche¹⁵ and others attempted to stop cardiac pain by sectioning intercostal nerves. These attempts resulted in failure. Cardiac pain persisted even though the somatic nerve supply of the chest was interrupted.

In view of the established fact that cutting the intercostal nerves distal to their juncture with the sympathetics will not abolish cardiac pain it is difficult to conceive how anesthetizing the somatic component in the periphery of the chest wall can accomplish this purpose. Also, the fact that tender dermatomes or even tender peripheral nerve patterns are rarely found makes it less likely that these trigger points are somatic.

For many years theories were expressed concerning the viscerosensory reflex with skin hyperalgesia developing in those spinal segments having connections with diseased viscera (Head Mackenzie theory).¹⁶ These hyperalgesic areas supposedly were the surface expression of the painful stimuli of visceral disease. Attempts to apply the theory on a clinical basis, however, show that it is unreliable and generally unsatisfactory. From observation of patients over a period of years with organic abdominal disease preceding and following abdominal surgery, and from experience gained by negative abdominal exploration, one is led to believe that the presence of segmental pain and tenderness is not the result of painful visceral stimuli. It is to be stressed that local, nonsegmental skin tenderness is, of course, commonly encountered in visceral disease, either as a result of irritation of the parietal peritoneum or by sympathetic irritation from bombardment of the segmental levels affected.

With the advent of abdominal surgery and greater knowledge of the pathological processes in the truncal viscera, the parietes of the thorax and abdomen were neglected. Yet the parietes give rise to painful situations not related to visceral disease. Just as the combination of pain and tenderness occurs in the extremities due to various

occur in the nerves which

f the segmental pain and

tenderness as cause of disability. One is the fact that many of us are

not conscious of the existence of this syndrome. The other is lack of

familiarity with the necessary methods of eliciting tenderness. It can-

not be emphasized too strongly that the tenderness in these cases must

be elicited by the examining physician. This tenderness may vary

anatomy in that region. This is as it should be, but when no visceral disease is found the body coverings should not be forgotten.

For example, pain and tenderness of long duration involving the lower quadrants may be labeled as chronic appendicitis or colitis depending upon the side involved. In most instances, if properly elicited, a segmental neuralgia will be found as the causative factor. Removing the appendix not only fails to relieve the pain but also in many instances produces an increase in pain. Because of the persistence of symptoms the abdomen may again be opened in search of adhesions. This is especially true if the patient visits a new surgeon.

Cholecystectomy may be followed by the same train of events. If an abdominal wall neuralgia is present, a positive Murphy sign or tenderness over the gallbladder region can still be elicited even after the gallbladder has been removed.

In any patient with chronic pain and tenderness of the abdominal wall, a careful examination of the back should be made. *If segmental neuralgia is present, surgery should be deferred until the spinal region at the proper level has been thoroughly investigated.*

In segmental neuralgia which involves the chest and abdomen, the treatment of choice for rapidity of results and duration of relief is paravertebral nerve block.

NEURALGIC ASPECTS OF LOW BACK PAIN AND LOWER QUADRANT ABDOMINAL PAIN

One must bear in mind that pain in the lower quadrants of the abdomen, the groin, the upper inner thigh, the costovertebral angle and the region of the iliac crests is the expression of dorsolumbar irritation when it is associated with tenderness of the skin segments of the eleventh and twelfth dorsal and first lumbar nerves. When so considered, neuralgia affects the twelfth dorsal and first lumbar nerves more frequently perhaps than any of the other nerves. The actual point of pain may be at any point within the segmental distribution so that while the complaints of the patient may lie within the distribution of the posterior primary divisions, tenderness of the anterior division is usually demonstrable and vice versa.

In low back pain having its origin at the dorsolumbar area, the patient's complaints may so closely simulate those of sacroiliac pain that diagnosis may be difficult without employing differential methods. If the dorsolumbar irritation affects the lower abdominal quadrants, the pain may simulate pain of any of the underlying viscera.

Many of us are familiar with the story of the laborer who after heavy lifting develops acute pain in the groin. He is immediately examined with the expectation of finding a hernia. The examination

L. 5, 6 = a lock for 1 segmental ten nerves

nosis of incipient hernia. This is as much back sprain as any condition in which backache is the complaint, except for the fact that the anterior fibers are the ones which develop spontaneous pain.

This phenomenon is often the explanation of why patients with segmental pain and tenderness of the lower right abdominal quadrant, with pain of months' or years' duration are told by their physicians that they are suffering with chronic appendicitis. In the course of the patient's wandering he or she visits an osteopathic physician. Treatment directed to the spine, perhaps baking, massage and a heel lift, may cause the patient's pain to subside or disappear. We frequently hear such patients state that their appendicitis was cured by an osteopath. The diagnosis of appendicitis was of course, erroneous when made by the medical physician.

BACKACHE IN ENDOMETRIOSIS

Backache may be the cardinal symptom of endometriosis. The pain was so intense in three of our cases that they were regarded by the gynecologists as orthopedic problems, even after the diagnosis of endometriosis was established. Gynecologists refused to operate, stating that such backache did not come from endometriosis. We mention these facts because the concept of severe persistent backache as the cardinal feature of endometriosis is not generally recognized, in spite of the fact that endometriosis itself is a recognized entity.

In our three cases the shortest duration of pain was two years, the longest nine years. Pain was constant and the cyclic features were those of acute exacerbations. In one case acute increase of pain came a day after the period was over and continued to persist for one week. In another the pain was severe and constant except for two days' relief following the period. A low grade fever ranging from 99° to 100.5° F was present. All cases lacked energy and were exhausted by only moderate activity. There was weight loss in all cases.

The backache in one case was associated with muscle spasm, and the patient limped when walking. Pain was diffuse throughout the lumbosacral spine with reference to the lower half of the buttock. Flexion and extension of the spine were painful. The pain was so intense that most of the time the patient remained in bed. At one time the pain was so severe that she was unable to stand erect or walk for several weeks. This particular case had a nodular infiltration of the posterior rectal wall. Pressure and pull upon this nodule reproduced
usually became

anterior aspect of the entire leg. This was associated with a tearing pain and spasm of the lower back. Usually it also involved severe vaginal pain. Nausea frequently accompanied the pain.

All three, at one time or another during the course of the disease, were diagnosed as psychoneurotics

The unquestioned diagnosis by tissue study and the dramatic relief of pain following castration leave no question as to the etiological relationship of endometriosis and severe backache

SCIATIC PAIN

Some etiologic factors of sciatic pain are common to pain elsewhere in the body. Other causes are local and pertain particularly to the lower lumbar spine and its surrounding structures

As elsewhere, there are transmitted and reflex types. The former consists of lesions which directly affect the roots, trunks, plexuses or branches of the sciatic nerve. Among these are trauma with or without fracture, arthritis, disease of the spinal canal, ruptured intra-vertebral disk, hypertrophied ligamenta flava, inflammation of the meninges, spinal metastases, constitutional disease, toxins (bacterial and chemical), herpes zoster, vascular disease, spasm or swelling of the piriformis muscle, and rarely, a primary sciatic neuritis. In some cases the causes cannot be discovered.

Lesions causing reflex pain along the course of the sciatic nerve do so because of irritation of somatic structures supplied by branches of the sciatic distribution. These include sprain or strain of the muscles and ligaments of the lumbosacral and sacroiliac junctions, local lesions in structures supplied by branches of the sciatic nerve (a tendinitis of the gluteal muscles in the region of the hip joint is an example), injections of irritants into the structures supplied by branches of the sciatic nerve, and lesions of the lumbar spine and sacrum which do not directly irritate the roots or trunks.

Treatment is directed to the underlying cause. A herniated intervertebral disk is the most common cause of this condition. Clinical features of this syndrome are so well known that we will omit its description.

Infiltration of the sciatic nerve in our experience has been of definite value in controlling pain. The fear that a sciatic nerve injection of aqueous nonsclerosing solution will damage the nerve appears to be unfounded. In several thousand infiltrations no permanent damage to the sciatic nerve has been observed, nor has infiltration masked symptoms or interfered with diagnosis. On the contrary, we have routinely employed this method as part of our conservative treatment before resorting to spinal studies. In many instances it has relieved pain to a degree that satisfied us that no space-taking spinal lesion was present.

RELIEF OF PAIN IN OSTEOARTHRITIS OF THE HIP JOINT

In many instances of severe pain arising from the lesion of an osteoarthritic hip joint, the pain does not come from the destroyed

portions of the joint but from the periarticular structures which have had undue stress and strain and alteration of function placed upon them as a result of displacement of the bony supports. In addition, a low grade inflammatory reaction may be superimposed.

The structures which appear to be responsible for pain in most of these cases are the tendons of the gluteus minimus, gluteus medius, and perhaps, the piriformis. In most instances, deep pressure over the tendons causes severe pain. The pain may be localized to the region of the hip joint or, more often, it is referred to the lower portion of the extremity, to the posterior or posterolateral aspect of the thigh, and/or lateral calf, the pathway of pain often simulating that of sciatic distribution.

We have been able, on repeated occasions, to relieve severe pain of short or long duration in osteoarthritis of the hip joint by local infiltration of the tendons with procaine hydrochloride.

Not all patients with osteoarthritis of the hip joint are benefited by this form of therapy. Only those patients exhibiting tenderness above and behind the trochanter should receive local infiltration.

Such cases of tendinitis occur also in the absence of an osteoarthritis of the hip, and, because of the distribution of the reflex radiation into the leg, may at times be mistaken for sciatic pain.

The progress of the joint disease, of course, is not affected by this procedure, but the results in many instances have been so satisfactory that the method appears to be of value solely for the purpose of relieving the pain.

HERPES ZOSTER

Treatment.—Many forms of therapy have been advocated for herpes zoster, none of them, however, is sufficiently effective to be depended

iodide, injections of posterior pituitary extract, cobra venom, ultraviolet rays, diathermy, x ray, convalescent blood (350 to 400 cc) and 5000-unit injections of diphtheria antitoxin. The two latter forms of therapy were reported as yielding splendid results in ophthalmic herpes. In this condition the patient should be referred to the ophthalmologist without delay. During the acute stage, Woltman suggests intragluteal injections of the patient's own blood, using 10 cc daily

continuous pain which was not affected by the forms of therapy which were previously administered. For over ten years we have treated these cases by paravertebral nerve block, using procaine and ammonium sulfate. In the acute cases the results were excellent. In the

chronic cases of months' and years' duration little or no relief of pain was obtained. In observing the patients with chronic constant pain the complaint of a burning sensation, the causalgic character of the pain, and the fact that following nerve block with procaine no relief was obtained, has suggested the possibility that changes had taken place in the sympathetic ganglia or fibers. In these cases, sympathetic ganglion block with alcohol may be attempted.

INTRASPINAL ALCOHOL

This procedure² is based upon the fact that ethyl alcohol has a destructive action upon tissues and that it has a low specific gravity as compared to spinal fluid so that it can be floated upon the spinal fluid, thus, by adjusting the position of the patient the alcohol can be directed to the desired area of the posterior root in an effort to destroy the sensory fibers. Complications include bladder and bowel paralysis, motor involvement of the lower extremities, meningeal irritation, cloudy spinal fluid which subsides in a few days and even cranial nerve paralysis. The general consensus appears to be that the use of intra spinal alcohol is a well worthwhile procedure but that it is to be reserved for incurable cases and for patients who have severe pain which cannot be alleviated by other forms of therapy.

Technic of Injection.—It is first necessary to determine which spinal segments are involved. This is done by interpretation of the distribution of the pain. The patient is placed in such a position that the posterior roots involved will be uppermost, the patient being in a lateral position. The lateral plane of the back is placed forward about 35 to 40 degrees, which will aid in keeping the alcohol on a level with the posterior roots. The head and shoulders should be kept below the level of the area being treated. The spine at the area of injection may be arched in the lateral position by placing a pillow under the patient. This will form a slight arc in the spine segment to be injected, the convexity being upward.

A lumbar puncture is performed at the proper level. When free,

patient remains in position for one-half hour after which he may be placed flat on his back. Alcohol used for this procedure should be filtered and autoclaved.

The injections may be accompanied by a burning sensation in the distribution of the areas being contacted with alcohol followed by a sense of warmth and numbness. This should to some measure, give an idea whether or not the proper areas are being contacted. The degree and duration of pain following the injection may vary considerably. Relief of pain may be immediate, or it may be gradual or there may be no relief, depending upon the accuracy with which the

The patient should be kept flat on his back for several hours, and remain in bed for thirty six hours to make sure that headache or other signs of meningeal irritation have not developed. If the pain is bilateral, the other side may be repeated within a week.

Stern warns that more than 8 minims of absolute alcohol injected between the second and third lumbar segments will invariably cause bladder complications, and that doses larger than 16 minims between the third and fourth lumbar segments may cause rectal incontinence.²²

INTRASPINAL AMMONIUM SULFATE

After finding that the ammonium ion, within a certain range of concentration, depressed part of the sensory fibers without affecting motor function,²³ one of us (B D J) attempted to use the ammonium salts intraspinally.

In 1942, we published a preliminary report upon the use of this procedure as a method of therapy for the intractable pain of malignancy.⁴ We used a solution of either ammonium sulfate or ammonium chloride in 6 per cent solution (each cc containing 60 mg).^{*} The total amount administered varied from 200 to 400 mg of ammonium salt. This was a highly concentrated solution and it was necessary to dilute it freely with spinal fluid by means of barbotage in order not to have too high a concentration of the ammonium salts at any point within the intrathecal space. Too high a concentration would affect all fibers causing bladder, bowel and motor effect. The method was modified in 1943 to eliminate some of these risks.

Before attempting to apply this procedure a proper evaluation of the patient's physical status should be made. If the symptoms appear to be visceral in character, the procedure should not be used. If, however, there are signs of root irritation, namely, aggravation of pain by change in position or its association with segmental tenderness this type of therapy is indicated. Other signs and symptoms which suggest that spinal metastases are the cause of pain are further indications that the procedure will probably be of benefit. It was noted in the group of failures that pain was not associated with tenderness of the sensory segments in nearly all instances.

If the examination reveals that the disease process has already caused motor weakness or other neurological disturbances, intraspinal therapy may hasten an impending paralysis. The degree and extent of pain and tenderness should be noted in all cases so that changes following treatment may be accurately evaluated. Before attempting any form of spinal therapy the family should be notified of all possible complications and written permission should be secured for the procedure.

^{*} Reagent quality. Adjust solution to pH 7.2 with ammonium hydroxide using potentiometer. This preparation is for intrathecal use only.

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A lumbar puncture is performed at the proper level. When free, clear spinal fluid is obtained a tuberculin syringe containing 0.5 to 1 cc of 95 per cent ethyl alcohol is connected to the needle and the alcohol is injected slowly, taking about one minute to empty the syringe. The patient remains in position for one-half hour, after which he may be placed flat on his back. Alcohol used for this procedure should be filtered and autoclaved.

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of localized pain such as lumbosacral sprain, sacroiliac sprain, bursitis and osteoarthritis of the shoulder, osteoarthritis of the knee, spondylitis and similar types of localized pain.

The action of this substance appears to be more than just one of protein effect. This has been demonstrated in patients who have received intramuscular injection of this substance solely for its protein effect, and later received injection as described below with a much more marked therapeutic effect.

Treatment.—Coley's fluid is given by intradermal injection and administered locally over the area of greatest tenderness in the same manner in which one would use bee sting.

Its action is one of prolonged hyperemia, counterirritation, and general protein reaction. In several hours, the site of injection becomes intensely reddened and the patient experiences a short period of increased pain with a mild febrile reaction. This usually does not exceed 100°F. The local reaction remains for from two to four days. Occasionally chills precede the febrile reaction. The injection may be repeated once a week. The dose should never be increased to more than 0.05 cc. Larger doses cause a more severe reaction and no better therapeutic effect. Two to five injections are sufficient.

Technic of Injection with Coley's Fluid.—Shake bottle well and withdraw 0.03 cc using a tuberculin syringe. The needle which is used to withdraw the Coley's fluid should be discarded as its lumen will contain sufficient material to cause a reaction. Add to this sufficient 2 per cent procaine hydrochloride solution to bring the volume up to 0.15 cc. Inject one-half of the contents of the syringe intradermally over the selected tender area. Pass the needle through the skin and inject the remainder subcutaneously or use it for another wheal.

The patient should be told in advance just what reaction to expect otherwise he may become unduly alarmed at the time of its occurrence. Rarely if the Coley's fluid is not well shaken or if it is not properly diluted with procaine solution, a tiny area of skin may undergo necrosis. The purpose of the dilution is to make the injection more comfortable. The purpose of the procaine is to make the injection painless. The purpose of the dilution is to make the injection more comfortable.

Small nodules may persist for several weeks following its administration. These disappear completely in time.

Coley's fluid when used according to this procedure, both for its local and general effect, and for the purpose described, is superior to any other preparation we have used.

SOLUTIONS FOR INFILTRATION

Since 1939 we have been using ammonium salt solutions for nerve block. The action of the ammonium ion is that of depression of the C fiber potentials. The ammonium salts are to be used only for pain of

we have obtained and many of those reported have been excellent. However, at the present time, it must be considered to be a procedure attended by risk.

To determine the amount of preoperative medication, one should take into consideration the doses of opiates to which the patient has previously been accustomed. In a patient who has not become addicted, 16 to 20 mg ($\frac{1}{4}$ to $\frac{1}{3}$ gram) of morphine, plus 0.2 gm (3 grains) of amytal may be administered. Atropine sulfate, 0.9 mg ($\frac{1}{15}$ grain) will be of aid in lessening nausea and vomiting. A sensation of burning pain and heat may result following the injection. Most of these reactions are controlled by the above medication.

Procedure.—Premedication—The patient is given 0.2 gm (3 grains) of amytal forty minutes before lumbar puncture. Sufficient morphine and 0.9 mg ($\frac{1}{15}$ grain) of atropine sulfate are administered hypodermically twenty minutes before lumbar puncture. The bowels and bladder are emptied. Fluids are limited and the preceding meal is omitted.

Technic—The patient is placed on the side with the head down and

mg (6 to 65 per cent solution). The spinal fluid and the ammonium salt solution are well mixed and the entire amount is reinjected into the intrathecal space. Care should be taken not to change the position of the needle when detaching and attaching the syringe. The head should be kept well below the plane of the tapping site throughout the procedure. After the mixture of spinal fluid and ammonium salt solution has been replaced the patient is placed level and

COLEY'S FLUID*

For the past ten years we have had considerable experience using Coley's fluid to help us in our attempt to control pain. This consists of a mixture of the toxins derived from the *Streptococcus erysipellatis*

value in those conditions in which
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* Parke Davis & Company, Detroit.

According to Allen¹ the relief of pain takes place by transudation of procaine in areas where capillary permeability is increased in connection with the injury, inflammation or edema especially when the procaine is administered with considerable fluid intravenously. On the basis that a great majority of pain is associated with local inflammation or edema many conditions were treated by this method with often surprisingly good results.

and Wangersteen use 1 gm of procaine diluted with 500 cc of isotonic sodium chloride given intravenously by gravity drip method at a height of 4 feet above the bed. Graubard administers the procaine according to the weight of the patient using a minimum of 4 mg per kilogram and administers the desired amount within a period of twenty minutes using a meter to control the flow per minute.

Other conditions for which this method has been used successfully are the treatment of delayed serum sickness²¹ childbirth childbirth

effects

PHYSICAL THERAPY

The use of physical agents to control pain is valuable only if proper technic of application is used. Therapy must be applied to the source of pain. In x ray therapy if objective evidence of a lesion is not present the roentgenologist must depend upon the referring physician to indicate the area to be radiated. The physical therapist likewise is dependent upon diagnosis for local therapy.

In pain referred to the shoulder and arm from a lesion in the cervical spine it is common practice to apply therapy to the shoulder and lower arm. The source of the pain in the cervical spine is ignored.

Pain derived from the dorsolumbar spine may simulate sacroiliac pain. Treatment should not be given at the sacroiliac area but above at the twelfth dorsal first lumbar level.

In patients with sciatica the entire course of the nerve is treated with every conceivable form of therapy in spite of the fact that causes of sciatic pain are usually due to some disturbance in the lumbosacral region of the spine. This is often a herniated disk or other intraspinal space-taking lesion or a radiculitis or plexitis. Also reflex sciatic radiation may take place from skeletal structures of the low back region.

In neuralgias which affect the chest wall or abdominal wall the area of spontaneous pain may develop in any part of the dermatome anteriorly or posteriorly. Usually these conditions are associated with tenderness which is of segmental distribution. If this tenderness is

the transmitted type which as mentioned is associated with nerve pattern tenderness. The formula is as follows:

	Per Cent
Ammonium sulfate	0.75
Benzyl alcohol	0.75
Sodium chloride	0.48

The purpose of the benzyl alcohol is to alleviate the initial sting of the ammonium salts. The sodium chloride is added to make the solution isotonic. The solution is then adjusted to pH 7.2 with ammonium hydroxide.*

For structures such as muscles, tendons and ligaments, we have used 1 or 2 per cent procaine hydrochloride solution, omitting adrenalin. The use of alcohol for local infiltration of somatic nerves has so often been followed by a chemical neuritis that we have avoided its use wherever possible.

INTRAVENOUS PROCAINE

Within recent years a new procedure, the use of intravenous procaine, lends promise of becoming an important means of pain control. A number of observers have reported upon this type of therapy. Nearly all of them agree that this method is of definite value in the relief of pain. Their statements allay the fear of the toxicity and possible allergic reactions which might result from this drug. Indeed there are some reports in which the intravenous procaine is used as a treatment for allergy with good results. Waldbott¹ however reported severe allergic shock in a case in which 0.5 gm. of procaine in 250 cc. of saline solution was given intravenously for the relief of urticaria.² He feels that sensitization to the drug is particularly apt to develop in patients with chronic urticaria, since they are liable to have second and third injections of procaine after intervals of a few weeks in a

Intravenous procaine seems to be of particular value in cases of trauma or where sympathetic release is desired. The actual blood concentration is not sufficient to be anesthetic. However, drugs are reported to have a concentration of seven or eight times in injured tissues as compared to normal tissues. Most of the writers agree on this theory. Leriche feels that the action involves paralysis of spasm and of atonic activity of the autonomic nervous system rather than anesthesia per se.

Graubard³ states that procaine has a twofold action: (1) direct action on the irritated nerve fibers and the poorly insulated sensory

* Harvey Laboratories, Philadelphia, Penna.

According to Allen¹ the relief of pain takes place by transudation of procaine in areas where capillary permeability is increased in connection with the injury inflammation or edema especially when the procaine is administered with considerable fluid intravenously. On the basis that a great majority of pain is associated with local inflammation or edema many conditions were treated by this method, with often surprisingly good results.

Lundy uses 1 gm dissolved in normal saline and administers 500 to 1000 cc. Leriche states that 10 cc of 10 per cent procaine administered slowly produces an effect equal to that of stellate ganglion block. State and Wangenstein use 1 gm of procaine diluted with 500 cc of isotonic sodium chloride given intravenously by gravity drip method at a height of 4 feet above the bed. Graubard administers the procaine according to the weight of the patient using a minimum of 4 mg per kilogram and administers the desired amount within a period of twenty minutes using a meter to control the flow per minute.

Other conditions for which this method has been used successfully are the treatment of delayed serum sickness²¹ childbirth childbirth and perineal suture instrumental deliveries and impacted intracapsular fractures. The largest dose given amounted to 425 cc with 4.2 gm of procaine in the course of one and three quarter hours with no toxic effects.

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tion may take place from skeletal structures of the low back region.

In neuralgias which affect the chest wall or abdominal wall the area of spontaneous pain may develop in any part of the dermatome, anteriorly or posteriorly. Usually these conditions are associated with tenderness which is of segmental distribution. If this tenderness is

present, the point of spontaneous pain should not be treated. Therapy should be applied to the spine or the paravertebral region. In a scalenus anticus syndrome it is of no value to treat the shoulder, arm or cervical spine. If any form of physical therapy can cause the scalenus anticus muscle to relax, it should be directed to the course of the muscle itself, and not to any area of referred pain.

These are but a few examples of how great effort, time and the use of valuable material is expended upon areas of referred or reflex pain which are distal to the source of the primary irritation. Under these circumstances, little benefit can be derived from such treatment.

Positive findings in x-ray studies should be correlated with pain levels. Osteoarthritic changes, congenital defects and the like may be ignored as sources of pain if they do not correspond to the painful segmental levels.

FAILURE TO OBTAIN RELIEF

Failures should be investigated from several angles. If a paravertebral nerve block does not erase the segmental tenderness within a few minutes, the nerve has not been properly infiltrated.

If the segmental tenderness disappears and the pain persists, it may be caused by (1) A lesion proximal to the point of infiltration, namely, in the intervertebral foramen or in the intravertebral structure.

(2) A lesion distal to the point of infiltration, namely, in the segmental tenderness has been anesthetized. (3) A visceral lesion which may coexist with the segmental neuralgia. (4) Medicolegal complications, where the patient refuses to admit relief of pain. Malingerers will not produce segmental tenderness, but the patient may exaggerate the

the pain recurs shortly after the anesthesia subsides, an intraspinal lesion must be kept in mind.

In a minor percentage of patients, the origin of the pain can be

difficulties with states of tension, anxiety, and other emotional disturbances may become so prominent as to completely mask a primary cause for pain. A normally stable individual, on the other hand, may undergo personality changes if pain of prolonged duration is experienced without relief. To these cases the term somatopsychic could

be applied Incomplete diagnostic studies or lack of objective signs at the time of examination may be the cause Applying the term psychosomatic to patients only because no disease or evidence of the cause of pain can be found is an implication that we have knowledge of all the causes of pain This is far from the truth

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MODERN TRENDS IN SURGERY OF THE THYROID GLAND

FREDERICK A. BOTTE, M.D., F.A.C.S.*

THE most common diseases of the thyroid gland that the surgeon is called upon to treat are (1) goiter, (2) thyroiditis and (3) malignancy. Goiter is by far the most frequent, thyroiditis, particularly of the chronic types, is not uncommon, and malignancy is quite rare.

GOITER

Preoperative studies are made on all goiter patients to determine whether hyperthyroidism is present, and secondly, to detect any evidence of tracheal obstruction. Occasionally thyroidectomy is performed for cosmetic reasons only. If hyperthyroidism is found treatment is directed to overcome existing instabilities, several disturbances in metabolism and in severe cases to treat liver damage. Laryngoscopic examination, including a study of the vocal cords should be performed in all cases. Lateral and anteroposterior x-ray studies of the trachea should be made to visualize any compression or deviation of this structure.

In hyperthyroidism the patient is suffering from instabilities of (1) the central nervous system, (2) the sympathetic nervous system, (3) the cardiovascular system and (4) the emotions. Most thyroid services have developed a routine method of treating the symptoms which these instabilities produce. As has previously been reported, it was found that the symptoms due to the instability of the sympathetic nervous system namely, profuse sweating, nausea, vomiting and diarrhea, were more constant and more severe in the diffuse toxic goiter and the cardiac symptoms were more pronounced in the toxic nodular goiter. More attention should be given to the careful management of the emotional instability. Every effort should be made to study the conditions in the patient's home life that aggravated this disturbance and psychotherapy instituted to overcome them. Careful management of this factor has been of value in both the preoperative and postoperative periods.

Iodine; Thiouracil.—The alteration in iodine metabolism is the most important of the metabolic disturbances. Iodine in some form is used to treat this condition, in most institutions it is prescribed either as Lugol's solution or potassium iodide. In 1943 Astwood introduced thiouracil for the treatment of hyperthyroidism. The physiological

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activity of this drug has been repeatedly described in detail in the literature. Increased experience with it showed that the number of permanent remissions obtained in treating hyperthyroidism was not as great as had been hoped for. Certain toxic reactions were reported, the most significant of which were anemia and agranulocytosis. In view of these findings frequent routine blood counts should be made when a patient is taking this drug. Little or no change occurs in the blood before seven to fourteen days have elapsed but it is safer to begin to check the blood counts earlier. If recognized early and the drug is discontinued this complication is rarely fatal. Beierwaltes and Sturgis reported an analysis of ten fatal cases which they were able to collect from the literature and other sources. The results obtained with thiouracil in recurrent cases following thyroidectomy have also been disappointing. In the Presbyterian Hospital in New York it was used in twenty-five recurrent cases; fifteen showed recurrence of symptoms in from one to three months after discontinuance of the drug. Thiouracil produces hyperplasia and increased vascularity of the thyroid gland. This change increases the severity of hemorrhage in the course of a thyroidectomy in patients prepared with this drug. Propylthiouracil has been used more recently and has proved to be much less toxic than thiouracil. While no clinical reports have been made which claim it to be more efficacious than thiouracil the diminished toxic effects are a decided advantage. These drugs have not replaced thyroidectomy but they have proved to be of value in the preoperative preparation of patients with severe hyperthyroidism. They are used until there is an appreciable improvement in the symptoms and the basal metabolic rate; then iodine is substituted to complete the preoperative preparation. Many clinicians are now employing them routinely either in patients who are obviously too great a surgical risk for thyroidectomy or refuse operation.

Disturbances in Calcium and Phosphorus Metabolism—Not infrequently marked disturbances in calcium and phosphorus metabolism occur in hyperthyroidism. In 1891 Von Recklinghausen described the demineralization of the skeleton in the postmortem study of a case of hyperthyroidism of many years duration. Since that time this condition has been observed clinically in many patients. Early writers called our attention to this process in the small bones of the hands and feet. More intensive studies showed that the decalcification frequently involves the entire skeleton. Occasionally this finding by x-ray leads to the diagnosis of hyperthyroidism in a case of long duration with mild or obscure symptoms. It is not uncommon for a spontaneous fracture to occur in a patient who has had the disease for a long period. Aub demonstrated patients with hyperthyroidism in a negative calcium balance; however they do not have the changes in the blood calcium and phosphorus which are characteristic of hyperparathyroidism.

Disturbances in Carbohydrate Metabolism—A disturbance in

in the dosage of insulin used until the patient's condition can be thoroughly evaluated. As the hyperthyroidism responds to treatment the insulin becomes more effective and the required dosage diminishes rapidly. Failure to recognize this may frequently result in insulin shocks. When severe diabetes and hyperthyroidism exist it has been necessary to do thyroidectomy in two stages in about 45 per cent of the cases. In one patient with a very large goiter it was necessary to operate in three stages. Not infrequently, after the hyperthyroidism is controlled, patients having a fairly high insulin requirement before operation may control their diabetes for many years on diet alone.

Foci of Infection—In the preoperative study a careful search should be made for all foci of infection. If an operation is needed to eradicate them this should not be performed until four to six months after thyroidectomy. It has been shown repeatedly that an infection such as influenza or pneumonia may precipitate severe hyperthyroidism. Likewise any focus of infection may aggravate a preexisting clinical picture of hyperthyroidism. In view of this some advocate removal of foci of infection as a part of the treatment of hyperthyroidism in the hope of avoiding thyroidectomy. In some cases there is either marked improvement or disappearance of symptoms after the foci have been removed. In others even though the operative procedure be of a very minor character severe crises have been precipitated and occasionally fatalities have occurred. These experiences have been responsible for the dictum that no surgical procedures should be undertaken in hyperthyroidism except those directed toward the thyroid. All foci of infection should be eradicated after thyroidectomy has controlled the hyperthyroidism as they may be the cause of recurrence of symptoms.

ated upon for some other surgical condition. Clinically these patients appear to have mild hyperthyroidism; the tachycardia is not pronounced and the weight loss may be slight extending over a period of six months to several years. Their facial expression is apathetic; the

skin is dry and wrinkled and they appear to be older than their actual age. In some patients prolonged studies are necessary before an accurate diagnosis can be made. These patients are poor surgical risks and they require a much longer preoperative preparation than their symptoms would seem to indicate. The mortality in this group has almost disappeared with careful prolonged preoperative preparation and operation in two stages with an interval of four to six weeks between operations, as Lahey advised.

Liver Damage and Diminished Liver Function.—In the past fifteen years just as in other surgical diseases, we have learned that liver damage and the diminished liver function in patients suffering from hyperthyroidism contribute greatly to the surgical risk and operative mortality of thyroidectomy. For many years jaundice had been observed in severe cases of hyperthyroidism but this observation did not awaken us to the degree of liver damage associated with this disease. It was not until 1933 that we had any pathological report of the damage in the liver associated with hyperthyroidism. Then Weller described the chronic lesion as a patchy, chronic, parenchymatous interlobar hepatitis and Beaver and Pemberton observed the acute changes.

hyperthyroidism or in a crisis. The bromsulfalein and hippuric acid tests are used, but some investigators prefer one of the other liver function tests. It is recognized that no liver function test is entirely reliable and should serve only as a guide in the treatment of this complication. Such studies should not supplant clinical judgment in evaluating the operative risk of any given case. In the past few years in cases that show moderate or marked liver damage we have added to our routine treatment several therapeutic measures which are suggested by Cheskey and his co-workers. They include (1) intravenous glucose with insulin (1 unit to every 2 gm. of glucose), bile salts, liver concentrate 1 cc. every other day intramuscularly, and glycine. We have been favorably impressed with these measures and have used them in several cases even though the liver function tests were not unfavorable, when the clinical response to our routine measures did not seem satisfactory. Some investigators believe that damaged liver function is such an important factor in thyroid crises that they should be called liver crises.

Optimal Time for Operation.—To determine the best time for operation as each case should be considered. When basal metabolism falls to normal or near normal it is usually safe to operate. This criterium however, is far from being infallible. Many patients, such as those with severe cardiac disease, have an elevation in the basal metabolism when no hyperthyroidism is present. Others have

much more severe hyperthyroidism than the rise in the basal metabolism indicates. The best example of this is the patient suffering from apathetic hyperthyroidism. The basal metabolic rate should be considered as a measure of the degree of hypermetabolism rather than

tories, however, owing to their present complexity and cost. Simpler and less expensive methods of determining the blood iodine are needed. If the pulse rate remains below 100 the hyperthyroidism is usually well under control. Another guide which some surgeons depend upon is the patient's weight. In several hospitals it has been adopted empirically that if the patient has lost 20 pounds or less he is ready for operation when he has regained one third or more of his weight loss. With some individual variation these three criteria—the basal metabolism, the pulse rate and weight gain—form the basis for the determination of the time of operation in many hospitals.

The Physician-Anesthetist in the Reduction of Operative Mortality.—On most well organized goiter services the operative mortality of thyroidectomy is less than 1 per cent. Careful preoperative preparation and the use of stage operations in cases of severe operative risk have contributed greatly to this low figure. Another important contributing factor has been the recognition and treatment of liver damage. The addition of the well trained physician anesthetist to our operative team has also been very helpful. In addition, his efforts have contributed to the prevention of complications during and after operation. In the event of a respiratory difficulty he is able to examine and determine the mobility of the vocal cords at any time during or after the completion of the operation. Not infrequently large quantities of mucus may be encountered during the course of an operation

ination made at the completion of the operation may be a little inaccurate if an intratracheal tube had been used. In such cases the vocal cords are re-examined several hours later if necessary. Frequently large quantities of mucus are aspirated from the trachea before the

Recurrence; Postoperative
 3 per cent of all patients
 recurrence of symptoms
 reoperation, others require
 is removed, *hypothyroidism* develops. If a patient develops symptoms

of hypothyroidism postoperatively thyroid extract should be used cautiously. Many patients showing signs of this complication ten to sixteen weeks after thyroidectomy require only small doses of thyroid extract ($\frac{1}{4}$ grain three times a day) for ten to twenty days to have restitution of normal thyroid function. If thyroid extract is used in too large doses over a longer period of time the hyperthyroidism may recur. A careful follow up is necessary in the study of these cases. Fortunately we have a complete replacement in thyroid extract if hypothyroidism should persist. In rare instances *hypoparathyroidism* has developed when the parathyroids have been removed. This is a less fortunate complication as we have no complete replacement therapy for this deficiency. Parathormone can be used for a short time and this is replaced by AT 10 which can be taken as long as is necessary.

A technical complication of operation is *paralysis of the vocal cords* due to injury to the recurrent laryngeal nerves. If only one cord is involved it is usually compensated for in time and the disturbance in the voice disappears. If both cords are paralyzed the case should be studied by the surgeon, otolaryngologist and bronchoscopist. When the paralysis is secondary to postoperative edema it will subside. If it is due to nerve injury temporary or permanent tracheotomy may be necessary. The King operation in which the vocal cords are relaxed has been helpful in some cases. There are two complications which many believe to be pituitary in origin, namely persistent hyperthyroidism and progressive exophthalmos after the hyperthyroidism is controlled. Ever since Loeb and Basset reported the production of hyperplasia of the thyroid gland following the injection of the extract of the anterior lobe of the pituitary gland we have speculated as to the number of cases of hyperthyroidism that are pituitary in origin.

THYROIDITIS

Chronic Types. Riedel's Struma and Hashimoto's Disease.—Thyroiditis occurs in both the acute and chronic types. The first description of any form of chronic thyroiditis was made by Riedel in 1896. In the description of the microscopical picture of his type of thyroiditis he stressed particularly the diffuse fibrosis with round cell infiltration as the characteristic change. In 1912 Hashimoto described the type of thyroiditis in which there was extensive lymphocytic infiltration accompanied by the formation of mature lymph follicles with germ centers. For some years due to the influence of Ewing it was felt that the type described by Hashimoto was an earlier form of Riedel's thyroiditis. In 1931 Graham made a complete clinical and pathological study of these two types of thyroiditis and concluded that they should be regarded as two distinct types.

Differential Diagnosis.—Since Graham's work detailed studies have been reported in which there were a number of findings which differentiate these two lesions. When an analysis is made of the reported

cases, it is found that Riedel's thyroiditis occurs in either sex in individuals usually under 40 years of age, whereas Hashimoto's disease is practically always found in women in the later decades of life. The entire thyroid gland is involved in Hashimoto's disease whereas in Riedel's struma it is confined to one lobe in approximately 30 per cent of the cases. It is of interest to note that in Hashimoto's disease does not extend

it may break through

explains why we see obstructive symptoms so much more frequently in cases of Riedel's thyroiditis than in those of Hashimoto's disease. The gland is harder in Riedel's struma and therefore is more easily mistaken for the extreme firmness of malignancy. On the operating table the gland of Hashimoto's disease has a grayish purple color and may be enlarged to two or three times the normal size. On the surface there may be extreme lobulation almost to the point of appearing as lymph nodes adherent to the capsule. Upon compression of the lobe between

the capsule. Compression of the gland between the fingers reveals a yellowish white color. On the incised surface of the gland in Riedel's struma the color is very similar to the external surface and there is little or no colloid present. This is usually confined to small areas of the gland which probably contain the remaining normal thyroid tissue.

The follow up studies in the two types show that in Hashimoto's disease approximately 75 per cent of the patients develop various degrees of hypothyroidism whereas in Riedel's struma only about 30 per cent develop hypothyroidism. This great difference may be accounted for by the fact that in some cases only one lobe is involved in Riedel's struma.

Little has been added to the microscopical picture which both Riedel and Hashimoto described. Many glands removed for hyperthyroidism show small areas of diffuse fibrosis and round cell infiltration and others may show areas of lymphocytic infiltration even to the presence of one or more germ centers. These should not be confused with the types of chronic thyroiditis just described. A frozen section should be made at the time of operation to differentiate these lesions from malignancy.

Management and Results—If there is no evidence of malignancy and the microscopical diagnosis of either Riedel's or Hashimoto's type of thyroiditis can be made, only one lobe should be removed. This procedure has been used to save as much thyroid tissue as possible in an effort to prevent or postpone the development of hypothyroidism. In the event of obstructive symptoms it may be necessary to remove additional tissue to prevent the progress or recurrence of these symptoms.

To date I have had fourteen cases of chronic thyroiditis on my service at the Presbyterian Hospital and one at the Jeanes Hospital. Of this group five proved to be Riedel's struma and ten were Hashimoto's disease. The two oldest patients who were 67 and 77 years of age respectively had Riedel's thyroiditis. The follow up studies showed several facts which were thought to be worthy of mention.

In two cases of Hashimoto's disease which have been followed for nine years the remaining thyroid tissue has enlarged somewhat. There is no clinical evidence of hypothyroidism and the basal metabolic rates are within normal limits. In another Hashimoto case even though hypothyroidism was present before operation the gland was so hard that a total thyroidectomy was performed in the belief that the gland was malignant. Months after operation this patient developed hypoparathyroidism. The delay in the development of this added complication led to the speculation as to whether it was due to surgery or whether the disease had spread to involve the parathyroid glands. It has been advocated that perhaps Hashimoto's disease spreads to other glands of internal secretion. This patient was operated upon in 1936.

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ary to an upper respiratory infection and the vast majority of them respond to nonoperative measures. Occasionally a localized abscess results and this is treated by incision and drainage. The usual collar incision is made and the posterior portions of the gland should be explored as not infrequently these collections localize posteriorly. A milium type of acute thyroiditis has been described. It is treated by subtotal thyroidectomy to obtain the best drainage. Fortunately this type is very rare as it is highly fatal.

CARCINOMA OF THE THYROID GLAND

Carcinoma of the thyroid gland is a relatively rare condition. The prognosis is poor. The commonest type is the colloid carcinoma.

puberty. It also emphasizes the necessity of careful examination of adenomatous tissue removed at operation. This is particularly true if there is a history of recent enlargement in a long standing adenoma.

Several years ago a patient who had an adenoma in the thyroid for twenty years had marked enlargement four months before operation. The gland was not adherent to the surrounding tissues nor did it exhibit any other evidence of malignancy. The pathological report of the tissue examined was benign adenoma. Four months later the

patient was readmitted to the hospital, having developed two small nodules in the scar. The nodules were excised and the pathological report of the tissue removed was recurring carcinoma of the thyroid. The original specimen was then reexamined and sections of tissue taken from the center of the adenoma showed the identical cellular structure of carcinoma as was found in the nodules. This malignant

total thyroidectomy should
be thyroid out

been added to the management of the malignant cases. It has been shown that this substance may be used in two ways—first, as a tracer to detect the presence of metastatic lesions by means of the Geiger counter, and second, to treat malignancy. At the Memorial Hospital in New York, it has been demonstrated that radioactive iodine is picked up only by the metastatic lesion in which the tissues are carcinomatous. The substance could not be detected in tissue of the metastatic area the histological structure of which was that of normal thyroid tissue. Opinions differ as to the results obtained by the use of radioactive iodine in treating malignancy. Much more experience is needed before we will know its real value.

RECENT ADVANCES IN PULMONARY SURGERY

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FRANK TROPEA, JR, M D,† AND LAURENCE H RUBENSTEIN, M D ‡

HEMOTHORAX

NUMEROUS advances in the management of patients with chest injuries were made during the last war

In the treatment of hemothorax, it has been definitely established that early and repeated aspiration without air replacement favors

"(1) It relieves high intrapleural pressures, (2) it removes an excellent culture medium for bacterial growth, (3) it aids in early expansion of the lung—a definite advantage in limiting the area of empyema if infection occurs, (4) it decreases the incidence of massive clotting, (5) it prevents the later fixation and contraction of the thorax. As a result of experience gained during the war years no limit is placed on the amount of blood removed at each aspiration. All patients are now aspirated as dry as possible, with quantities as high as 2200 cc having been removed at a single aspiration. This procedure is very well tolerated by most patients, the number of aspirations necessary is very definitely reduced, and the incidence of

small number of patients may complain of tightness in the chest which also subsides after several hours without specific treatment

The incidence of complications in the treatment of hemothorax is usually directly proportional to the adequacy of early management. Decortication for the treatment of constrictive pleuritis and sup-

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purative constrictive pleuritis (empyema) has altered our entire concept of the management of pleural space infections. Early thoracotomy with complete evacuation of the pleural space, removal of fibrinous membrane from the lung surface complete re expansion with positive pressure anesthesia, and the use of closed suction drainage offers the only possibility of cure without multiple operations and a protracted convalescence. The ability to obtain and maintain prompt expansion of the lung obliterate the pleural space and prevent accumulation of blood or other culture media have contributed most to the success of this procedure. The use of penicillin parenterally and intrapleurally is undoubtedly an important factor in the brilliant results obtained with this procedure. Miscall and Harrison report a closed nonsuppurative pleural space in less than fourteen days in 80 per cent of patients operated upon for suppurative constrictive pleuritis and, no mortality in a series of seventy five decortications many in the face of severe infection.

In the management of combined thoraco-abdominal wounds much experience has been gained in the transpleural and combined thoraco-abdominal approach to lesions of the left upper quadrant. Surgery of the lower end of esophagus cardiac end of the stomach and the spleen will more and more be approached transpleurally for facilitation and completeness of operation.

BRONCHIECTASIS

This chronic lung disease is far more common than recognized or believed to exist. It must involve at least two million people in the United States. Some of these cases are mild but in the vast majority the sufferers are doomed to chronic or recurring invalidism and an early death from "pneumonia" or a less common complication (e.g. hemorrhage brain abscess asphyxia).

Conservative (Palliative) Treatment—Once the anatomical changes are well established with associated persistent infection there is absolutely no chance of cure by conservative measures. All that can be expected or hoped for is a palliation of the symptoms by persistent treatment. The role of a hot dry climate daily postural drainage and frequently repeated bronchoscopic aspirations (one to four week intervals) are valuable and well known prophylactic measures against acute flare ups. They are also therapeutic as far as the individual pneumonitic flare ups are concerned. Penicillin or the other antibiotics may be of great value in aborting or controlling these episodes especially when the chief offending organisms concerned in the particular exacerbation can be shown to be sensitive to the drug. The sulfonamides should also be of value but in our experience are not especially effective. The use of the sulfonamides or antibiotics by direct endotracheal instillation or by spray inhalation (aerosol) would not seem to be especially logical since the effect of these drugs de-

tends largely upon the blood local and since the associated bronchial

many favorable reports of such use are now in the literature. Certainly there can be no harm in trying the effect of direct inhalation if systemic effect is lacking or unsatisfactory. Perhaps combining the two methods (local and systemic) would offer a chance of better results than either alone.

Surgical Measures.—It must of course be remembered that all conservative measures are essentially palliative or effective directly against a complication rather than curative of the primary disease itself. Surgical removal of the affected bronchopulmonary segment or segments is the only logical and curative therapy. The disease may involve a whole lung, a lobe, two or more lobes, a sublobar segment, or more often several sublobar segments scattered perhaps through several lobes and perhaps in both lungs. Careful objective estimation of a patient's pulmonary function, accurate delineation of the entire bronchial tree by bronchography, and bronchoscopic evaluation of the local condition have changed the former haphazard and inadequate study of these patients to a careful and complete evaluation of the patient's ability to stand surgery, and the exact nature and extent of surgery required. In addition the improved understanding of the disease and of infections generally has led to earlier recognition and recommendation of surgery, permitting a much less advanced group of patients to receive its benefits. Preoperative measures such as trans-

inflation of the lung have done much to increase the safety and ease of these operations.

Thoracic surgery has made even greater strides in the treatment of this disease than in any other of the common pulmonary ailments. Today it is possible to remove all but two of the five (or six if the lingula is considered the left middle lobe) usual pulmonary lobes if necessary to extirpate the rest for bronchiectasis. If the patient has been properly studied and the surgery is uncomplicated, he may well expect to lead a normal life. Two such patients, performing all their own deliveries without handicap.

Segmental Resection.—Since bronchiectasis has a tendency to involve segments in several, perhaps all lobes, it is the development and refinements of segmental resection which has offered the most striking recent advance in this disease. Churchill and Belsey,¹ Blades and

Kent,² Overholt and Langer,³ and others have presented techniques for the resection of individual pulmonary segments without seriously damaging the adjacent ones. These methods all depend upon the delineation of the normal from the pathological segments by incomplete or complete sublobar fissuring by localized atelectasis or fibrosis and most of all upon differential inflation of the normal segments after clamping the bronchus to the diseased segment. Some of these methods embrace division of lung tissue between clamps. In one of them the bronchial system to the involved segment is actually torn out.

Of these techniques perhaps the best is that of Overholt and Langer.³ They merely strip the involved segment away from the rest of the lung along the normal cleavage planes after dividing the appropriate bronchus and segmental branches of the pulmonary artery and vein. Bleeding points on the adjacent lung surfaces are controlled by hot packs and ligatures and no attempt is made to suture or cover the remaining raw surface. Thus the remaining lung tissue is permitted to expand freely in all directions to readjust the relations of the diminished lung to the thoracic cavity. This technic is especially recommended in resection of the basal segments of the lower lobe while preserving the superior division. It is also applicable in resection of the lingula with preservation of the true left upper lobe.

However, the authors have found this method and all previous ones to be defective in a fairly large percentage of segmental resections and based upon a suggestion of one of us (L. H. R.) have devised an exact and nearly fool proof method of outlining any given pulmonary segment. It too depends upon exact anatomical knowledge of the location and relations of the segmental bronchi and only slightly less important the locations of the segmental arterial and venous pulmonary circulation. If any doubt exists about a vessel's distribution, it is not divided or ligated until the progress of the pulmonary dissection has made its association clear. Thus anomalies of vascular distribution do not lead to impairment of circulation or necrosis of other pulmonary segments.

In the method of differential inflation of lung segments it is often found that even after clamping or dividing a segmental bronchus nearly normal inflation of that segment takes place. The collateral air passages are more effective in the inflation of these smaller segments. Thus the removal of a single basal segment (rather than the entire four or five in the

this unless seriously infected and devascularized tissue is left behind

very formidable

On the other hand, in the presence of very severe segmental disease the affected portions are atelectatic, pneumonic or fibrotic, or some combination of these. In these cases there is no difficulty in visualizing the true line of demarcation and establishing a cleavage plane. Thus it would seem that an attempt should be made, where no such extreme

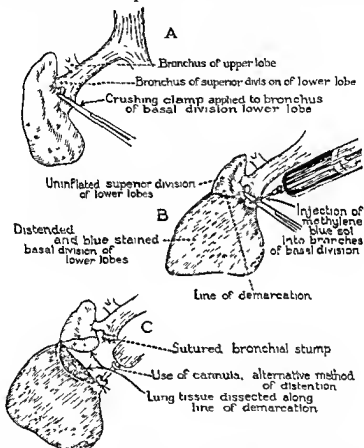


Fig 419—A, Injection of mixture of one part 2 per cent methylene blue and two parts of 3 per cent hydrogen peroxide into segmental bronchus distal to clamp (in this case the basal division bronchus)

B, Injected segment becomes distended and blue stained, and firm to touch

C, After division of the segmental bronchus and vessels, clean separation of the stained tissue from the remaining segments is feasible

pathological changes are present, to produce a change in the appearance or consistency of the involved segment. We have found that both changes can be produced in the following manner: After isolating the appropriate segmental bronchus and confirming the accuracy of this opinion by recourse to a knowledge of the specific anatomy, by

Kent,² Overholt and Langer,³ and others have presented technics for the resection of individual pulmonary segments without seriously damaging the adjacent ones. These methods all depend upon the delineation of the normal from the pathological segments by incomplete or complete sublobar fissuring, by localized atelectasis or fibrosis and most of all upon differential inflation of the normal segments after clamping the bronchus to the diseased segment. Some of these methods embrace division of lung tissue between clamps. In one of them the bronchial system to the involved segment is actually torn out.

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less unless seriously infected and devascularized tissue is left behind excessive operative hemorrhage and permanently impaired pulmonary function. The removal of such tissue becomes a

measure may be questioned. The patient's general condition is built up preoperatively to a high level by *vitamin therapy*, *hypernutritive diet*, and *transfusions*. Even though the blood count is normal, an average of 1000 cc. of blood is given preoperatively in chronic lung disease on the basis that the total blood volume in these cases is routinely reduced, perhaps as much as 30 per cent. Blood is given at operation in a quantity equal to that lost. Gentle suction on the drainage tube (up to 15 cm. of water) is used routinely to favor prompt lung re expansion whenever drainage is employed.

Bronchoscopic aspiration is routinely performed before the patient leaves the operating room. It is repeated at any time (night or day) by the resident or staff surgeon, usually in bed, if there is any indication of retention of secretions or of atelectasis. A simple method of obtaining adequate local anesthesia of the larynx and tracheobronchial

cent cocaine) is injected directly into the trachea with a No. 22 $1\frac{1}{2}$ inch needle inserted through the midline of the skin of the neck. The patient coughs as soon as the solution enters the trachea thus bathing his larynx, pharynx and the distal bronchial tree with the anesthetic. We have seen no difficulty with this method, and even with inexperienced operators we routinely see tracheobronchial anesthesia superior to that

inserted under direct vision between the cords. Oxygen from a portable tank is kept flowing through the bronchoscope at all times at a rate of 3 to 4 liters a minute during these bronchoscopies—thus avoiding even temporary oxygen deprivation. The trachea is aspirated, and the bronchoscope is inserted first into the bronchus of the unoperated side to cleanse it and assure maintenance of life before any attempt is made to aspirate the diseased side (which probably cannot yet maintain life anyway). These postoperative bronchoscopies have been life saving measures many times on our service, but more often have been means of avoiding morbidity—collapsed lobes on the operative side, pneumonia, failure of re expansion, empyema and the like.

Obviously it is better to prevent than to treat such accumulations of bronchial secretions. Therefore we routinely employ many different measures each of which is effective in certain cases but not in all. Deep breathing exercises, carbon dioxide inhalation, encouragement to cough up secretions at frequent intervals, turning the patient from side to side every hour during the early postoperative period—all have their quota

differential inflation and deflation of the lung, or other means, the bronchus is clamped. A No 17 needle with the distal $\frac{1}{4}$ inch bent at a right angle is inserted through the wall of the bronchus distal to the clamp and into its lumen (Fig 419, A) Five to 15 cc. of a mixture of one part sterile aqueous 2 per cent methylene blue and two parts of 3 per cent hydrogen peroxide is injected slowly through this needle. Almost at once the visceral pleura over the involved segment becomes blue or green, and the entire segment becomes swollen and tense (Fig 419, B) When the segment is distinctly outlined, the needle is withdrawn and an extra clamp is placed across the punctured portion of the bronchus. No pleural soiling with the dye should occur if the procedure is carefully done. The bronchus is then cut proximal to the two clamps, the stump and residual tracheobronchial tree are carefully aspirated with a laryngeal suction tip inserted through the open end, and the stump is closed using interrupted fine cotton or steel wire sutures in two rows, one row tied over the cut end, and one row of proximal mattress sutures. The pulmonary arteries and veins supplying the segment are divided between ligatures of cotton, and gentle traction is made upon the distal end of the divided bronchus. The normal cleavage plane is sharply delineated by the contrast of the blue firm diseased segment with the pink soft tissue of the normal segment. By careful dissection, mainly blunt, the entire segment is accurately removed (Fig 419, C) Very little bleeding occurs from the raw surface and that is controlled by pack pressure and few ligatures.

The bronchial stump is covered by one or preferably two layers of viable tissue which is sewn accurately to and around the bronchial cut end. Usually there is enough available parietal pleura to make a pedicled flap for this purpose. Free grafts of pleura or fascia are acceptable but undoubtedly inferior to vascularized grafts. Sometimes we cover the bronchial stump by suturing the visceral pleura of the remainder of the lobe over it. This is undesirable if it interferes with the vascularity or expansibility of the remaining lung tissue. The pleural space is drained by a No 24 urethral catheter with extra windows cut into it. The tiny air leaks in the raw surface seal over spontaneously in a few hours or days. The catheter can then be removed leaving the hemithorax completely filled with expanded lung tissue.

GENERAL MANAGEMENT OF MAJOR CHEST OPERATIVE CASES

Naturally, in order to achieve routinely satisfactory results, and to

larly) One hundred thousand units are also placed directly into the pleura at the time of operation, although the necessity for this latter

such as coma brain injury apoplexy, pneumonia and debilitating diseases where tracheal secretions accumulate and tend to produce asphyxia atelectasis or terminal pneumonia. Certainly innumerable lives could be saved in this manner.

In those cases in which the tube cannot be easily and dependably passed into the trachea and in which the need for frequently repeated aspirations is evident bronchoscopy is obviously not the answer since it is not feasible to repeat it oftener than twice a day. Here is a definite indication for *tracheotomy*. This may be performed in the formal manner with division of the third or fourth tracheal ring or in an emergency a laryngotomy may be promptly and simply performed through a midline button hole incision with division of the cricothyroid membrane. A large tracheotomy tube is used (No 5 or 6) and secretions can readily be aspirated with a large catheter as often as every fifteen minutes night and day. In a very sick patient oxygen can be administered by a catheter passed through the tracheotomy tube. Since the eddies of the oxygen current mix with the alveolar air much of the need for voluntary respiratory efforts is removed. Thus labored breathing is relieved permitting the patient to rest and husband his strength. (This treatment is most effective in thoracoplasty patients with severe paradoxical respiration.) It is desirable that the oxygen be bubbled through water to moisten it before insufflation into the trachea.

ABSCESS OF THE LUNG

A lung abscess may be defined as a nonspecific destruction of lung tissue with formation of a cavity. It is usually caused by bacterial infection especially by the pyogenic and anaerobic organisms. Sterile abscesses can occur usually due to vascular changes. They may become secondarily infected.

While pulmonary abscess may be caused by a wide variety of etiologic mechanisms—foreign bodies tumor infection of a cyst laceration of the lung certain infective organisms such as the Friedlander bacillus or fungi embolism with sterile or infected clots bronchial aspiration of infected particulate matter—only the last two methods are of much clinical importance.

Pathology—The weight of present medical opinion favors bronchial aspiration as the common causative process. The patient is believed to aspirate a bit of particulate matter into the depths of the tracheobronchial tree. This actual matter may be of many varieties for example food vomitus tartar from teeth blood clot bit of tonsillar or dental substance a definite foreign body. The particle descends until it lodges in the smallest bronchus which can accommodate it. Edema and inflammation of the bronchial mucosa soon develop and complete the partial or intermittent bronchial obstruction produced by the particle. The swelling of the mucosa grips this

are routinely gotten out of bed within twenty four hours of operation often within four hours. They are encouraged to walk as soon as possible. This raises their morale, improves their circulation, makes them breathe more deeply. They do not get secondarily weak from lack of use of their muscles.

The *transnasal, transglottic tracheal suction* recommended by Haight is probably our most effective routine measure to encourage evacuation of the tracheobronchial tree. It is performed without special order by both student and staff nurses on our service on all patients after major chest surgery. If the patient (and this includes most patients) does not like the treatment (which temporarily chokes him and makes him cough violently in spite of pain or desire) he will prefer to cough violently and effectively of his own volition. At any suspicion of backsliding in this respect, the procedure is threatened or repeated. The great virtue of this method is that it may be repeated as often as desired night or day, without requiring the presence of a member of the house staff. Unfortunately, in about 25 per cent of persons, a catheter cannot be easily passed blindly into the trachea by this means.

The technic of this procedure on our service is as follows. With the patient in a Fowler position, the nurse pulls on his tongue with a piece of gauze. A new, large size (No. 18) Levin tube, well lubricated, is passed through the largest nostril as far as the oropharynx. The patient is instructed to breathe in and out deeply and the tube is quickly inserted another 3 to 4 inches during inspiration. In 50 per cent of cases the tip of the tube passes between the vocal cords with ease. Strong suction is applied to the tube with a motor while it is moved back and forth in the trachea. An attempt is made to pass it into each main bronchus in turn by bending the neck extremely to the opposite side. The suction is interrupted after each 60 to 90 seconds of use in order that the patient may breathe around the tube. The suction may then be repeated again and again until all available secretions are removed. While the accuracy of directed aspiration such as obtained by bronchoscopy is not possible by this means, the irritation of the tube produces vigorous coughing and violent bronchial peristalsis. These effects help evacuate portions of the bronchial tree which cannot be reached by the tube. As soon as the secretions are thrown into the trachea they are removed by the suction. In those cases where difficulty is experienced in passing the tube into the trachea multiple repetition of the attempt will often be effective. Even if the tube curls up in the pharynx it will often induce effective coughing. At any rate the method seems safe unless the suction is continued too long when the patient may become cyanosed (since air is removed

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It is difficult for the authors to understand why this simple method does not have more popularity in the treatment of other conditions

Acute Uncomplicated Abscess—The acute uncomplicated abscess is one less than two months in duration and consisting of a single loculus or cavity. It may respond to bronchoscopy, postural drainage or antibiotic therapy, individually or in combination. Probably these cases always warrant a short trial with such conservative therapy. Those patients which will recover spontaneously or following conservative treatment show first a reduction in the foulness of the sputum, then in the amount of the sputum, then a progressive change of the sputum from purulent to mucopurulent to mucoid, with simultaneous subsidence of the pneumonitis by x ray, lowering and perhaps disappearance of the fluid level, and progressive shrinkage of the cavity. Those which do not show steady changes of the above type or show them intermittently are not getting well. Their disease is becoming chronic or complicated. They should be treated by prompt rib resection and cavernostomy.

It is of the utmost importance in establishing surgical drainage that the surgeon should exactly *localize the abscess* and should enter it without traversing the free pleural space. In other words, the drainage should be established through the area of adherence of lung and chest wall which is produced by the severe pulmonary infection. In our practice localization is accomplished in the following manner. A posterior anterior and a lateral x ray of the chest is taken and rough localization is accomplished. The patient is then fluoroscoped and rotated with the operator's hand applied over the abscess. If the hand remains fluoroscopically adjacent to the abscess it must be really properly placed. If the hand and abscess become fluoroscopically displaced on rotation of the patient, they are not approximated and readjustment is necessary.

After the abscess is localized this way a needle is inserted through the chest wall at this point still under fluoroscopic guidance. About 5 drops of methylene blue are injected into the intercostal muscles just below the rib to be resected or between the two to be resected in larger abscesses. The patient is then immediately taken to the

operating room and the chest is opened by the resection of the ribs.

The abscess cavity. The recovery of pus or free air of a foul character is adequate to assure the accuracy of localization. The cavity is then unroofed moderately and packed with gauze impregnated with a creamy suspension of activated zinc peroxide (ZPO) in water. This packing is changed daily using fresh ZPO each time. The odor of the drainage at first extremely foul is due to the anaerobic or micro aerophilic bacteria present. The nascent oxygen given off by the peroxide inhibits their growth producing a prompt loss of foulness and a marked reduction of the virulence of the bacterial mixture.

particle so that there is no longer the possibility that it can be coughed up

Atelectasis of the pulmonary segment supplied by this bronchus supervenes as soon as the contained air is absorbed by the intact blood supply. Should the obstructing particle be relatively clean and the bronchial tree distal to it free of organisms, no infection may develop at least for a considerable period of time. If infective organisms are present on the particle or in the distal bronchus a pneumonitis of variable severity is set up. When the anaerobic or necrotizing bacteria frequently found about the teeth and gums are primarily concerned a very severe pneumonitis is set up with later central necrosis of the segment. This necrotic portion becomes liquefied. The process spreads in the segment until it involves the segmental bronchus beyond the point of the obstruction. The obstructing particle, if soft and organic, may also be liquefied. If it is hard it will be released by solution of the contained bronchus to fall into the enlarging cavity or expelled into the bronchial tree. In either instance the bronchus becomes patent into the cavity so that air can enter it and the liquefied contents can escape into the bronchial tree. This may occur quite suddenly the patient having a coughing spasm and expectorating a large amount of purulent, perhaps bloody sputum. When anaerobic organisms are present in the cavity (as is usually the case) the sputum is very foul.

Subsequent to the establishment of bronchocavitary communication the x ray which has previously shown only the shadow of pneumonitis and pleural reaction now reveals a cavity with a fluid level surrounded by pneumonitis. Depending upon the adequacy of bronchial drainage the fluid level remains high in the cavity or becomes lower and perhaps disappears. There are some cases in which clinical bronchocavitary communication never develops and no air ever enters the cavity which appears on x ray as a rounded shadow resembling a peripheral lung tumor if the pneumoni is subsides.

Treatment—The treatment of lung abscess may be divided into three phases (1) prevention (2) treatment of the acute uncomplicated abscess, (3) treatment of complicated and chronic lung abscess.

Preventive Measures—Prevention includes all measures which forestall bronchial aspiration such as special care by dentist and pharyngeal surgeon, care in eating, care of the unconscious patient, refraining from placing foreign bodies in the mouth (children). It also comprises treatment during the stage of atelectasis and pneumonitis in an attempt to avoid tissue breakdown and cavity formation. Bronchoscopy, postural drainage and the systematic exhibition of the antibiotics, and perhaps the sulfonamides have their greatest value in this stage. Later on they are more likely to be merely adjunct to surgery.

by opening the abscess during forcible intrapleural dissection. While the hilar dissection may be most difficult and the patient's condition precarious, mass ligation of these structures is most undesirable since it leads to secondary bronchial stump opening and nearly inevitably to severe anaerobic empyema. Usually persistent dissection will permit an anatomical ligation and division of each structure. Secondary empyemas after removal of these anaerobically infected lungs are usually foul and virulent. Sloughing of the bronchial stump with development of bronchopleural fistula, or late hemorrhage from sloughing of the hilar vessels is not uncommon with these necrotizing empyemas. It seems to us that meticulous surgery, generous use of antibiotics locally and generally, and secure closure of the bronchial stump are especially important in these cases.

In spite of the added risks of pulmonary excisional surgery in this type of case, the results with other surgical measures are so poor that they should be reserved for those patients who cannot possibly be prepared or considered for the more major undertakings. These measures include cavernostomy, thoracoplasty, Schede pneumonectomy and the lobectomy.

forms of surgery are nearly always left with permanent residual draining sinuses, or residual pulmonary infection, or both. We do perform open drainage on a few debilitated individuals with single large chronic cavities. After healing has become well established and the pulmonary suppuration has practically disappeared, we attempt to obliterate the bronchocavitary cutaneous sinus by suturing a pedicled flap of muscle from the chest wall to the bottom of the now clean cystlike cavity. This staged operation has been very effective in our hands in treating a limited number of chronic cavities in aged and infirm patients.

PULMONARY TUBERCULOSIS

It is with some diffidence that the authors express their present feelings as to the surgical treatment of pulmonary tuberculosis. It seems that most of the time honored and presumably sound principles upon which the surgical treatment of tuberculosis has been previously based are now under severe scrutiny and some of them have been completely revised or even discarded. One of us (FT) has said "I don't know how to treat tuberculosis anymore." Another (CPB) has said "I don't blame people for not believing us when we report what we are doing today. I hardly believe it myself."

Rest general and local is still recognized as valuable. However, there is little tendency today to depend blindly upon rest treatment unless progressive improvement is objectively evident under this regimen. Gain in weight and strength mean little unless there is simultaneous absorption of lesions, closure of cavities, and conversion

Systemic antibiotics should be continued for a week after drainage. Handled this way, vigorous healing processes are prompt in appearance.

If palpation of the pleura after resection of the ribs reveals no induration, and if the lung can be seen to move below the transparent parietal pleura, either there are no visceroparietal adhesions over the abscess, or else localization is inadequate, usually the latter. If it is believed that localization has been inaccurate, a localized extrapleural stripping is undertaken first in the suspected direction of the abscess, then in other directions if it is not readily found. Unless the localization has been so inaccurate as to be of negligible value, an area of induration is palpated. If the abscess is not found, the procedure is repeated in another manner, perhaps with resection of an additional rib.

In cases in which no pleural adherence has developed over the abscess (rare, but they are seen), it is our practice to place the patient under general endotracheal anesthesia and to open the pleura widely. The lung is palpated and the abscess is easily located. The lung is then re-expanded by positive pressure on the anesthesia bag, and then is sutured to the pleural opening in such a way as to exteriorize the abscessed portion. If there seems to be no great need for immediate drainage, the chest wall wound is packed for seven to ten days to facilitate pleural seahog before opening the abscess at a second stage. If the need for immediate drainage seems great, the abscess is opened at once after reassuring ourselves that the pleural suture line is air tight.

Complicated and Chronic Abscesses—These are cases with multiple cavities in a single lobe or lung, cases with giant cavities, cases over two months in duration, those with atelectasis of the involved region, those with excessive residual and active pneumonitis. It is our belief that the vast majority of these cases are better off with pulmonary resection than with any other surgical measure. Needless to say, transfusions, antibiotic therapy and conservative drainage measures are of the greatest value in preparing these often extremely debilitated patients for surgery. It is usually possible to prepare them well enough so that they do go successfully through even the most radical resections. The postoperative care is equally important, especially with re-

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ing to various degrees of stenosis. While usually secondary to active pulmonary lesions and presumably due to direct implantation of the bacteria upon the bronchial mucous membrane, the process may pursue an independent course once well established. The treatment of these cases then becomes complicated, requiring attention both to the parenchymal and the bronchial disease.

Endobronchial disease involving smaller bronchi and bronchioles is much less serious than the same process in the larger bronchi. Indeed it seems likely that there is nearly always some degree of tuberculosis of the smaller bronchi in active pulmonary tuberculosis.

bronchial lesions

Advanced endobronchial tuberculosis of the major bronchi or their first divisions is a very serious complication of pulmonary tuberculosis and is a general contraindication to collapse therapy especially artificial pneumothorax. The reasons are related to the obstruction of bronchial drainage by the process (especially in the granulomatous and stenotic phases). Artificial pneumothorax produces a much better concentric collapse of the lung than any other measure and along with this there is symmetrical diminution in the caliber of the bronchial tree. Thus the bronchus which is partially obstructed may become nearly or completely obstructed following the institution of pneumothorax collapse. The retained secretions soon flood the bronchial tree in the obstructed lobe or lung producing the phenomenon of "drowned lung." There may or may not be particular shrinkage of this lung tissue since its air content is partially or completely replaced by the bronchial exudate. Interestingly either of two phenomena now takes place but rarely both together. The pyogenic organisms trapped in the obstructed lobe may set up a pyogenic pneumonitis with suppurative bronchiectasis or even abscess. The patient then shows all the usual evidences of sepsis—chills, irregular fever, sweats, rapid loss of weight and strength, progressive anemia. Or else the tubercle bacilli overgrow all other bacteria trapped in the obstructed lung and set up an extensive tuberculous pneumonia of the entire obstructed portion. Some of these cases show severe toxemia with high fever but many are subacute with low grade symptoms. Caseation takes place frequently leading to bronchopleural fistula.

"Tension" or check valve cavities are not infrequently seen in pulmonary tuberculosis. Typically these cavities are perfectly round, often very large, with relatively thin walls and usually contain a fluid level. They often change size appreciably for no apparent reason. If an aspirating needle is inserted through the chest wall and the cavity pressure is taken it is found to be well over one atmosphere.

of sputum. The advent of an at least temporarily effective antibiotic (streptomycin) and recent refinements of surgical technic have made it possible to attack successfully some problems previously almost beyond control.

The surgical methods presently employed may be described as of three general types: (1) collapse, (2) drainage and (3) excisional.

Collapse Treatment: Artificial Pneumothorax.—The collapse measures are still the most widely employed, and of them artificial pneumothorax is still the most popular. However, we are becoming very critical of the way it is employed. Maintenance of an ineffective pneumothorax (one which does not close cavities) beyond a short trial period (perhaps up to six to eight weeks) is definitely questionable practice unless there is some hope of improving its effect by some adjuvant measure. Such measures are closed or open pneumonolysis, phrenic paralysis, pneumoperitoneum, or any combination of them. It is clearly recognized that the prolonged maintenance of an ineffective pneumothorax in a tuberculous patient carries a much greater hazard than that of an effective pneumothorax—perhaps up to a 15 to 20 per cent eventual mortality. Pneumothoraces which produce a poor anatomical collapse are seldom effective by themselves; again adjuvant therapy should be considered.

It is no longer considered proper to maintain a great pneumothorax collapse if the disease can be controlled by partial collapse or preferably by selective collapse of the diseased portion of the lung. Prolonged extensive collapse of a lung leads to fluid formation, to diaphragmatic adherence of the pulmonary base close to the mediastinum and to extreme difficulty in re-expansion after the pulmonary disease is considered healed. This difficulty in reexpansion is usually related to the binding down of the lung by a partially organized fibrinous exudate, loosely and inaccurately called "thickened pleura." This exudate, as Mulyhill⁴ has shown, can practically always be removed by the procedure of decortication as described in the treatment of

cases cavities may sometimes reappear if the cavity bearing segment is fully reexpanded.

Gradually it is becoming accepted at the various clinics that diagnostic bronchoscopic examination should be part of the routine study of every tuberculous case before any definitive therapy is undertaken including pneumothorax. Tracheobronchial tuberculosis is now believed to be present in 15 per cent of all cases of pulmonary tuberculosis. The mucosa submucosal swelling, ulceration, granulation, healing with fibrosis lead

plasty will probably be chosen more and more for the relatively early thin walled cavities limited to the upper lobe. The conversion rate in such cases should be well over 90 per cent.

At the present time there are two general types of thoracoplasty performed for tuberculosis. The *classical thoracoplasty* is performed in stages through the same curved parascapular incision (Fig 420). The large back muscles are cut in the line of skin incision and the scapula is retracted away from the thorax, permitting excellent exposure of the costal grille. Recently Brock⁶ has advised that the incision be carried close to the spinous line permitting section of the trapezius and rhomboideus tendons along the spinous ligament. The muscles are thus protected against permanent denervation and fibrosis.

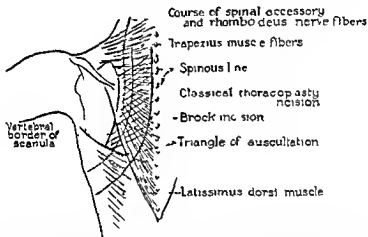


Fig 420—Diagrammatic representation of the anatomy concerned in postero-lateral thoracoplasty. Note how the Brock incision by cutting the muscles away from the spinous ligament preserves the nerve supply of a considerable amount of muscle tissue.

Also closure can be securely accomplished with a single layer of sutures through the muscle tendons rather than by multiple layers of suture through muscle and thin fascia (Fig 420).

The classical thoracoplasty and some shock. Thus persons refused the benefits of this as paradoxical breathing and tuberculous spread are not uncommon after a stage in which long lengths of as few as three ribs are removed. Some operators avoid these complications by only removing two or even one rib at a stage. Others do not take great lengths of ribs, especially anteriorly, thus reducing the mobilization of the lung in the region of the poorly supported anterior chest wall. Frequently

perhaps to as high as 40 mm mercury pressure. This phenomenon is due to a valve mechanism produced usually by endobronchial tuberculosis of the bronchus which drains the cavity, with resultant partial bronchial obstruction. Such cavities do not respond well to collapse measures unless the resulting general reduction in the bronchial caliber produces a complete obstruction of this partially occluded draining bronchus. More often the valve mechanism is made more efficient by diminishing the bronchial lumen causing the cavity to increase in size. The explanation of the valve effect is related to the "diastole" or expansion of the bronchial lumen during inspiration permitting air to pass into the cavity, and the "systole" or contraction of the bronchi completing a partial obstruction of the draining bronchus on expiration and preventing the air from escaping from the cavity.

When a pneumothorax is given in a case of "tension" cavity increase in pulmonary collapse results usually in enlargement of the cavity. The increased intracavitary pressure not infrequently leads to spontaneous rupture of the cavity wall with formation of a bronchopleural fistula (and often of tension pneumothorax) followed by simple or mixed tuberculous empyema. Therefore it is usually wise to abandon the pneumothorax promptly in any case in which evidence of the existence of a tension cavity in that lung becomes apparent. Sometimes adjuvant measures (pneumonolysis, phrenic paralysis, pneumoperitoneum) in such a case lead to "kinking" of the partially obstructed bronchus with formation of a complete obstruction and subsequent cavitory closure. The infrequency of such an occurrence and the danger of complications militates against too persistent attempts to bring it about. Packard¹ has successfully used streptomycin therapy during pneumothorax in a few such cases to heal the endobronchial disease and thus destroy the valve mechanism.

The development of pleural effusion or empyema during the course of pneumothorax therapy should lead to careful reconsideration of the whole case. Most of the time reexpansion of the lung to obliterate the empyema is in order. If further collapse is then required thoracoplasty is usually the best method of handling the situation. Frequently aspirations of the fluid and irrigations with antiseptic solutions (such as azochloramide and a wetting agent) are followed by reabsorption of the exudate and it is the authors' practice to do this whenever maintenance of the pneumothorax seems absolutely essential in a given case.

Thoracoplasty—This operation is still in extensive use especially in chronic cases of pulmonary tuberculosis. While it appears to give sputum conversion in about 70 per cent of cases so treated in the large clinics it seems probable that it is used in many cases in which the disease is so extensive that only a pulmonary resection could offer a cure. With the increasing safety and application of resection thoraco-

tric) and that therefore there is less effect upon the caliber of the larger bronchi than with pneumothorax. They hope to be able to collapse the peripheral cavities thus lessening the amount of infective secretions to pass over the ulcerated surface of the narrowed bronchus. This reasoning has sound basis but is subject to two considerations: first the bronchial ulceration may be self-perpetuating even if all parenchymal disease is controlled and second if a high degree of bronchial obstruction already exists the secretions behind that obstruction will never be able to escape and may produce severe sepsis.

At our clinic we prefer pulmonary resection to collapse for all cases of bronchial tuberculosis. Clinical bronchial healing does not seem impaired when division is made through an ulcerated area.

In certain cases of giant cavity and cases of tension cavity we may employ a combination of drainage and thoracoplasty. After a period of closed cavity (suction) drainage the secretions become thin and bacillus free. The cavity shrinks to a small sinus. A thoracoplasty may then be performed avoiding wound contamination from the drainage site. In our hands this has best been accomplished by first performing the anterior stage of the muscle splitting thoracoplasty and draining that wound. After healing is complete and the sero-hemorrhagic fluid is all absorbed a closed drainage is established anteriorly by passing a trocar and cannula through this incision and into the cavity. After drainage has diminished the size of the cavity and the amount of cavity secretions produced the posterior thoracoplasty stages are performed without risk of wound contamination. The drainage is maintained until all surgery has been completed. Welles and Gordon¹² have recently reported favorable results with a somewhat similar program of surgery.

For a long time the combination of closed drainage thoracoplasty in stages and finally Schede thoracoplasty has been the only program which has offered any hope of survival in cases of mixed infection tuberculous empyema and cases of bronchopleural fistula with or without mixed tuberculous empyema. However those cases in which there is a complete pulmonary collapse tend to maintain an apical infected space which will not heal. Deforming procedures such as scapulectomy and various forms of muscle plastic have been used indifferently. Recently a revival of the discarded operation of partial or subtotal claviclectomy by several persons especially Lambert³ has offered us an effective method of dealing with this persistent apical space.

However the above program is most unphysiologic and unanatomic. The patient even if his lesions are healed is seldom able to work again. In discussing pulmonary resection we will suggest a more desirable and promising method of treatment.

Phrenic Nerve Operations—These procedures temporarily or permanently paralyze the hemidiaphragm on the affected side causing it

such patients require a later anterior thoracoplasty stage to complete the cavitory closure

Such considerations have led various thoracic surgeons notably Finochietto,⁷ Head,⁸ Wangenstein,⁹ Bailey¹⁰ and Maurer¹¹ to devise different approaches to a permanent thoracoplastie collapse. At our clinic we have finally settled upon a modification of Jerome Head's *muscle splitting thoracoplasty*. While it requires somewhat more

it avoids the paradoxical breathing, tuberculous spread, shock, excessive hemorrhage, and most of the deformity and the arm and shoulder limitation so common in classical thoracoplasty. One stage more than would be used in the classical operation is usually needed.

Technic. The first posterior stage is performed in the lateral position, operative side up. A $4\frac{1}{2}$ inch incision is made $\frac{1}{2}$ inch to the upper side of the spinous line, and parallel to it, from the first dorsal spinous process down. The tendinous portion of the rhomboideus and trapezius is cut close to the spinous ligament. The scapula is elevated and the superior serratus posterior is divided. The posterior halves (approximately) of the upper three, four or five ribs are removed subperiosteally. The heads of the ribs are disarticulated and the transverse vertebral processes are removed, except the first. An apicolysis may be done if a marked apicobasal collapse is desired. The first anterior stage is done about seven days later through a 4 inch diagonal incision roughly over the second rib. The pectoralis major is split and the anterior remaining portions of the previously resected ribs are now removed subperiosteally along with the costal cartilages. Free communication is established with the posterior operative dead space.

The second posterior operation is done one week later or at a little longer interval if the patient's condition indicates delay. The incision is a transverse one over the triangle of auscultation. The triangle is enlarged by separating the muscles making up its walls (lower border of trapezius and rhomboideus and upper border of the latissimus dorsi). The next two, three or four ribs are now resected in diminishing lengths from above downward. Most of the uppermost one is resected. The heads of the ribs are disarticulated and the corresponding transverse processes are removed. Free communication is established with the previous operative dead space producing a smooth anatomical collapse. In cases requiring a complete thoracoplasty another stage is performed, usually posteriorly.

It is the custom of some thoracic surgeons to treat cases of tuberculous endobronchitis, especially cases with actual stenosis, by thoracoplasty. Their reasoning is that thoracoplasty is more productive of a peripheral collapse than pneumothorax (which is essentially concen-

siderably distressed by this persistent bronchocutaneous fistula and request that it be closed. A plastic operation involving the suturing of a pedicled muscle flap into the bottom of the cavity similar to that used in drained lung abscesses with epithelialized cavity is usually chosen. However, in a sizable percentage of cases even after prolonged drainage (six to twelve months) such closure of the sinus is attended by reformation of the cavity and recurrence of the positive sputum. Eloesser¹⁴ feels that all cavernostomy cases should have collapse of the thoracic walls as well as drainage in an attempt to obliterate the cavitory bearing region. He advises thoracoplasty for upper lobe cavities and phrenic paralysis in lower lobe cavities. Most operators reserve cavernostomy for those cases in which thoracoplasty has already been performed without accomplishing cavity closure.

Cavernostomy is sometimes done as a preliminary operation before thoracoplasty when the patient has a "tension" cavity or a very large cavity which may resist simple thoracoplastic collapse.

The favorite site for establishing cavernostomy drainage is an axillary one. This permits the patient to perform his own redressings.

"Monaldi" or Closed Cavitory Drainage with Suction—This type of drainage is used in some clinics in the treatment of very large and tension cavities. In our own clinic it is used mainly as an adjuvant to thoracoplasty in this type of case since we feel that thoracoplasty alone will fail to close most of them.

Our technic is very simple. Under local anesthesia a trocar and cannula are passed through a stab wound in the chest wall (usually anterior) directly into the cavity. The trocar is then removed and a No. 18 F urethral catheter is passed through the cannula into the cavity. The cannula is then removed and the catheter is sutured to the skin. A waterseal drainage bottle is attached and a suction pressure of minus 15 cm. of water is applied by a mechanical pump. For one to three weeks the drainage is purulent or caseous in type. It then becomes mucoid and eventually bacillus free. The cavity if "tension" in type shrinks rapidly, finally becoming a small sinus about the catheter. Again if there is no other cavity the sputum becomes bacillus free and scanty. These patients often gain remarkably after this simple therapy. However the problem again becomes one of maintaining drainage indefinitely. If the catheter is removed and the sinus is permitted to become closed the majority of cavities reopen with return of positive sputum. If other cavities or areas of active disease are present no conversion of sputum can be seen.

... usually to aid a thoracoplastic collapse of large cavities and of tension cavities where for some reason pulmonary excision is considered undesirable. Thus a

to become paradoxical and to rise in the thorax, markedly reducing the volume of that lung. After an initial period of overenthusiasm, these operations have come somewhat into disfavor as being relatively ineffective. The permanent paralyses are today rarely performed for tuberculosis because of the desirability of regaining lung function after healing of the lesions. Temporary paralysis by crush can be repeated several times if a prolonged paralysis is desired.

The effectiveness of phrenic nerve operations is difficult to evaluate since the results depend so much upon the type of disease treated. In a series of fifty cases in which phrenic crush was performed by one of us (CPB) at Devitt's Camp during the past four years for uncontrolled unilateral cavitory disease with positive sputum, 60 per cent became sputum negative and the cavities closed. In this series pneumothorax was either present and ineffective or was previously abandoned in most cases before the phrenic operation was performed. However, the pneumothorax was maintained in some of these cases, and pneumoperitoneum was established in some others, thus making it difficult to estimate the entire effect of the phrenic interruption. It was the impression of the sanatorium staff that without phrenic paralysis practically none of these cases would have been converted.

Drainage Operations—These are essentially (1) open cavernostomy and (2) closed catheter drainage with constant suction (Monaldi).

Open Cavernostomy—Cavernostomy is the oldest surgical approach to tuberculous cavities. It has been repeatedly tried and discarded. It has often been performed by mistake under the impression that the cavity was a lung abscess. It violates the old principle that tuberculous tissue should not be incised. However, we do not respect that principle so much today, especially since we have streptomycin.

The modern cavernostomy is frequently performed in two stages. In the first stage the incision is made over the cavity, and the rib or ribs overlying it are removed. The skin edges are then sutured to the pleura which is not opened. Packing is employed for a week or two. The wound granulates and the tissue spaces seal. After this period of time the cavity is opened and unroofed as widely as considered

with a siliastomy incision
the patient picks up a nonspecific respiratory infection. The bronchial communication produces various sound effects whenever the patient coughs, vomits, cries, laughs, strains in lifting or at stool. Sometimes these sound effects are very embarrassing. Most patients are con-

rather advanced. We feel reasonably confident that time will not prove them to be extreme.

The idea of completely extirpating a disease process is attractive and logical. It has been brilliantly successful in certain diseases such as appendicitis, and moderately disease. Usually tuberculosis is a process and thus not amenable to

is probably correct but clinically it is not entirely applicable. Certainly tuberculous disease can heal both generally and locally. For many years urologists have performed resection for tuberculosis of the kidney or epididymis. Gynecologists have done the same for tubal tuberculosis. While some of these patients have died later from tuberculosis, the majority of those who have been reasonably well except for this particular lesion have improved and remained well. In the vast majority of instances there has not been even a temporary post-operative flare-up of some other area of latent or inactive tuberculosis.

Likewise drainage procedures have been employed for the treatment of "cold" abscesses, and fusions for bone lesions. Rarely has sudden lighting up of additional lesions (perhaps by an allergic mechanism) been a prominent feature of these cases. And indeed in thoracic tuberculosis we have not hesitated to treat a lesion locally by pneumothorax, phrenic or thoracoplasty or even by one of the drainage operations (Monaldi cavernostomy). While there have been occasional flare-ups of disease in the same or contralateral lung, these have not deterred thoracic surgeons from continuing to perform these operations. In many cases they have been carried out even in the face of contralateral disease. Sometimes bilateral procedures are carried out simultaneously.

Thus it would seem unreasonable to refrain from pulmonary resection in tuberculosis either on the basis that it is a generalized disease unsuitable for local treatment or that resection of a tuberculous organ is especially likely to upset the existing organohumoral balance and cause widespread flare-up of the disease. Why then are physicians so reluctant to perform resections of tuberculous lungs? Actually it was unsuccessfully attempted in 1881 by Bloch¹⁵ and in 1883 by Rugg¹⁶. In 1891 Tuffier¹⁷ successfully removed the apex of a lung for a tuberculoma. Since then literally hundreds of such operations have been performed. The overall results have not been especially impressive and indeed some physicians consider them so poor as to permanently interdict the procedure. However, a careful scrutiny of the types of cases subjected to this surgery, the poor anesthesia in certain cases, the technique of the surgery employed which was often faulty by present standards, certain failures in preoperative and post-operative management and the like lead one to think that such simple statistical evaluation of results is valueless. Furthermore, the advent

better collapse of these cavities is assured, and at the same time any active disease in the region of the cavity is also collapsed. We have found this combination treatment extremely satisfactory.

Our routine is as follows. An anterior muscle splitting thoracoplasty is performed under local anesthesia and the wound is drained with rubber dam. We are especially careful not to remove long segments nor too many ribs. Removal of the costal cartilages and 2 inch segments of three ribs is adequate. Extensive decostalization at this time leads to paradoxical breathing difficulty in expectoration, and some times to spread in these cases with less than a good amount of an effective secretion. After the the operative dead space, a caliber (15 to 16 gauge) is introduced into the cavity. The pleural space has been obliterated in this area by the reaction from the thoracoplasty and drainage, even if no previous pleural adhesions had existed. The cavity location may be determined by fluoroscopy, or usually by merely aspirating air and purulent fluid from the cavity. With a scalpel a small incision is made alongside the needle which is then removed. The trocar and cannula are now inserted through this stab wound in exactly the same direction as the aspirating needle. When the cavity is entered the trocar is removed and the catheter is inserted. Suction is immediately applied and maintained until the secretions become thin and scanty (usually two to three weeks). The posterior stages of thoracoplasty are then performed in the usual manner being very careful not to enter the region of the drainage sinus. A routinely excellent collapse is obtained in this manner, with permanent cavitory closure in almost all cases. The catheter is removed about two weeks after the last thoracoplasty stage.

Resection for Pulmonary Tuberculosis—There is at present no more hotly disputed subject in thoracic surgery than the proper status of lung resection for tuberculosis. Some eminent thoracic surgeons feel that it is nearly malpractice to perform such operations except for very special indications. The most classical of these indications is severe bronchial stenosis with retention of tuberculous or suppurative secretions distal to it. Even here, some of them feel that a thoracoplasty should be performed first in the hope that with collapse of

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adequate antibiotic therapy, we feel that the limits to which resection therapy may be pushed in tuberculosis have not yet been determined but that they are far beyond what was even dreamed possible a few years ago. It will soon be evident to the reader that our views are

it has been used up to three months preoperatively and six weeks postoperatively. We believe two weeks preoperative and three weeks postoperative to be adequate. In no case, however, where streptomycin was employed (along with the best surgical technic and management of which we are capable) has there been any tuberculous spread in the same or opposite lung, regardless of the period of antibiotic therapy. Perhaps this is pure coincidence.

The mortality in the ninety-three cases operated without streptomycin was twenty five or 26.8 per cent (95 per cent). The mortality with streptomycin was five or 13.8 per cent. The first cannot be entirely attributed to the streptomycin since the first is an older series (dating back to 1941), in which time has taken its toll. Also, there had been a very appreciable change in operative technic



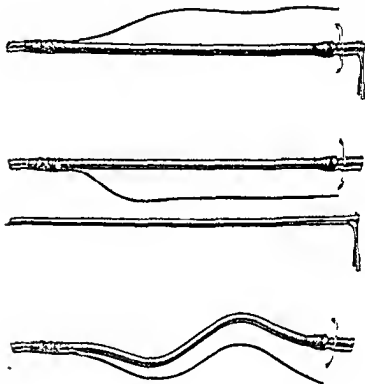
Fig. 422—The Overholt position (Overholt Comper Table) patient being face down and with operative side lower to facilitate the aspiration of infected secretions. This position is of immeasurable value.

long before the advent of streptomycin, from a rather crude one without drainage to a very meticulous one with drainage. Likewise anesthetic methods have improved so that today we use either endobronchial anesthesia with the Ruth Bailey tube (Fig. 421) or the Overholt face-down position, (Fig. 422) or both. These methods had markedly lessened the incidence of infection. Since streptomycin was available, the results have progressed steadily in the more and less hopeful cases for a

In 35 cases under streptomycin therapy the breakdown is as follows:
(1) One patient with severe bronchial stenosis of seventeen years' duration died on the operating table from hemorrhage because the inferior vena cava was inadvertently torn during a very difficult extrapleural pneumonectomy in which the pleura was up to $1\frac{1}{4}$ inches

and the availability of a really effective antibiotic, streptomycin, has changed the whole problem and rendered the results of all previous surgical attempts invalid

Our own experience, which includes 129 cases of pulmonary resection for tuberculosis, has been attended by a mortality of thirty or 23.2 per cent. In addition there have been nonfatal complications such



as spreads and draining sinuses in sixteen or 12.4 per cent. Of this entire series ninety three were operated without the advantage of streptomycin therapy, and thirty six with it. The amount of streptomycin has varied both in dosage and period of treatment. Thus in a few cases it has been employed for only three days preoperatively and two days postoperatively, in doses of 2 gm. daily. In other cases

of pneumonectomy and this was actually done in our first case and by Dr Sarot in his. The last two we have done without removing the parietal pleura apparently without untoward effects. The magnitude of the operation is much reduced if the pleura is not removed. Amazingly the thoracic wounds have healed per primum.

Indications for Pulmonary Resection—Our indications included all the usual ones and a few extra (1) tuberculoma (2) severe tuberculous bronchial stenosis with either distal sepsis or distal extensive caseation (3) check valve or "tension" cavities (4) very large cavities (5) "hilar" cavities (6) lower lobe cavities where pneumothorax was ineffective (7) bronchiectasis residual to tuberculous infection with persistent positive sputum (8) cavities which had resisted anatomically adequate collapse therapy (usually thoracoplasty) (9) destroyed lungs including cases of acute tuberculous pneumonia (10) bronchopleural fistula with mixed tuberculous empyema and a destroyed lung (11) a few elective cases which could probably have been treated successfully by other means.

The alternative to resection in at least half of our thirty six streptomycin treated cases was unquestionably death from progressive tuberculosis or continued sepsis. Of the other half we might perhaps have expected a 50 per cent conversion by collapse or drainage procedures with failure in the remainder. In other words of the thirty six cases eight or nine might have been salvaged by conventional means. As it is we have thirty one living patients twenty eight of whom have negative sputum and none of whom have draining sinuses, empyemas or bronchial fistulas. The three positive sputa appear to be due to residual bronchial ulceration in two cases to uncontrolled lower lobe tuberculosis in one case subjected merely to upper lobectomy. While it is impossible to give long term results at present

attending those means and supposedly even more common after resection for tuberculosis.

We have divided our indications in these thirty six cases as follows

Disease	No. of Cases
Tuberculoma	None
Severe tuberculous stenosis	5
Check valve cavities	3
Very large cavities	4
Hilar cavities	None
Lower lobe cavities	1
Bronchiectasis (clinical)	None
	10
	9
	3
	2

thick. (2 and 3) Two other patients died because of extreme reduction of vital capacity by the pulmonary resection. One of these had already had a bilateral thoracoplasty operation, the other had a total vital capacity of 1300 c.c. before removal of his diseased lung, which was about 50 per cent collapsed by a thoracoplasty. He survived the pneumonectomy but died after the subsequent thoracoplasty. (4) A fourth patient was a young woman with extreme amyloidosis with beginning renal failure in whom the procedure was performed with full knowledge of the risks and in the hope of stopping the metabolic process. The amyloidosis increased and uremia supervened. (5) The fifth case was a fair risk with extensive unilateral disease. The patient, a woman, died of shock not from the pneumonectomy but after the secondary thoracoplasty operation. Since two of the five deaths were subsequent to elective thoracoplasties performed merely to obliterate the pleural space, it can well be imagined that we are on the look out for a method of avoiding this secondary operation.

At the present time we still perform thoracoplasty to obliterate the pleural space after pneumonectomy and upper lobe lobectomy. Temporary phrenic paralysis is performed after lower lobectomy. We feel that the risk of late tuberculous empyema, of overstretch of caseous areas in the remaining lung tissue, and of destructive empyema in this remaining lung tissue require a procedure to obliterate the pleural space and to reduce the thoracic volume. Physiological studies of lung function before and after such thoracoplasties reveal that they cause a marked reduction of function. Perhaps, with streptomycin therapy we may be able to avoid some of these secondary operations.

We make no excuse for accepting these bad risk cases for surgery since we would undoubtedly do the same again. And indeed, equally bad cases are included among the successful ones. Thus we have included three cases of pneumonectomy for unilateral tuberculosis with mixed infection, tuberculous empyema, and bronchopleural fistula. So far all have done well and the pleural infection is apparently cured. It was at the suggestion of Dr. Irving Sarot of New York City that this treatment was attempted. It appears to be an eminently satisfactory approach to an extremely serious condition previously curable

thoracoplasty
 empyema
 persistent
 actually recovered, and they were usually so crippled as to be nearly useless to themselves and society. Frequently draining sinuses persisted indefinitely. Apparently with the help of the antibiotics (both penicillin and streptomycin simultaneously) we can now safely cross the infected pleura and remove the lung. By closing the bronchus constant reinfection of the pleura is prevented. It was at first thought that the entire infected pleural space should be removed at the time

chance of acquiring a primary bronchiogenic carcinoma. This incidence is borne out by studies of routine autopsies at large institutions such as the Charity Hospital in New Orleans, Philadelphia General Hospital, Cook County Hospital in Chicago, and others.

Bronchiogenic carcinoma is at least four or five times as common in males as in females. The disease usually occurs in persons over 40 years of age. However, it may occur at any age, our youngest patient being fourteen years old.

Pathology.—At the present time the disease is usually considered to appear in three clinical forms: (1) intrabronchial and hilar in origin (65 per cent), (2) peribronchial and hilar (10 per cent), and (3) peripheral (25 per cent). Pathologists are constantly producing new pathological classifications, but in general there are said to be three cellular types: (1) squamous or epidermoid carcinoma, (2) adenocarcinoma, (3) immature types, including undifferentiated cell, round cell or oat cell types. These are considered to be more malignant than the former types. Womack and Graham¹⁸ feel that in general there are two types: (1) squamous cell carcinomas, (2) mixed cell tumors. They believe that the so-called 'benign adenoma' of the bronchus is at least premalignant and undoubtedly is predisposed to change into this second variety of malignancy.

The central tumors arise from one of the larger bronchi and typically grow within the bronchus until they occlude the bronchial lumen. First a partial and later a complete bronchial obstruction is produced, which causes first an obstructive emphysema and later atelectasis of the lung tissue beyond the obstruction. Infection may complicate this picture causing pneumonitis, bronchiectasis or even lung abscess. The endobronchial growth may ulcerate causing bleeding. Metastasis tends to occur in the hilar lymph nodes first. These tumors usually present into "bronchoscopic" view, and are therefore eminently suitable for biopsy.

The peribronchial tumors grow around a large bronchus gradually pressing in on it from one or all sides. Since none of the tumor projects into the bronchial lumen, ulceration and hemoptysis are rare. Infection usually appears in the lung as the tumor produces more bronchial narrowing. Metastasis is often by direct extension into the hilum and mediastinum. Because there is no endobronchial growth, bronchoscopic biopsy is rarely possible even though these tumors involve the larger and more accessible bronchi.

The peripheral tumors are believed to arise from small bronchi or bronchioles. They tend to grow silently as rounded solitary masses for a prolonged period. Unless they become infected and break down centrally to form thick walled abscesses, they characteristically cause no symptoms until they reach the visceral pleura. Then one of two things may occur. They may produce generalized pleural carcinomatosis with development of "idiopathic" serous effusion. This effusion

This presumption of high salvage in this group must lead to an other. Had resection been performed electively in thirty-six cases of a type usually considered suitable for thoracoplasty, would not the results have been far better than in these thirty six? Would they not have been better than those usually accomplished by thoracoplasty? Certainly the technical difficulties encountered in resecting a lung after a previous thoracoplasty are many times that of a primary resection. Hemorrhage, shock, danger of cavitory rupture and so forth are far greater. It is the authors' opinion that from now on, more and more of these operations will be performed electively by an increasing number of thoracic surgeons in cases which might well be controlled by the older methods. The markedly reduced mortality and morbidity of lung resection promise to rival that of thoracoplasty especially in earlier cases. The higher percentage and greater certainty of sputum conversion will surely eventually influence thoracic surgeons to advise resection in preference to thoracoplasty in many cases.

There are many thoracic surgeons who will at least partially agree with the foregoing as applied to pneumonectomy, but who will doubt its validity in regard to lobectomy or segmental resection. Undoubtedly, they have a good point in that a pneumonectomy surely removes all pulmonary pathologic tissue on the operated side, while it is possible that some disease may be left after a lobectomy. This reasoning is even more valid when applied to segmental resection. However, if we are going to treat bilateral disease by bilateral resection, certainly some form of partial pulmonary removal must be developed. Also, as time goes by, certainly some efforts are going to be made toward conserving lung tissue even if only unilateral resection is contemplated. It would seem that since tuberculous nodules can be readily palpated through the lung surface, the extent of gross disease can be readily determined. It should thus be possible to remove only the diseased lobe or segment, conserving the rest. A suitable place for segmental resection would seem to be the superior division of the lower lobe when an upper lobectomy is performed, since this segment is frequently involved by tuberculosis. To date we have performed only ten segmental resections for tuberculosis, and except for

described in treating bronchiectasis, we expect to be able to remove any desired segment with accuracy as great in tuberculosis as in any other condition.

BRONCHIOGENIC CARCINOMA

This dread disease today causes 10 per cent of all deaths from malignant tumors. And since tumors cause about 10 per cent of all deaths, it will be readily seen that each of us runs a 1 per cent

bronchoscopic biopsy is usually obtained in 45 to 50 per cent of bronchiogenic carcinoma.

Examination of sputum may also reveal carcinoma cells but in a smaller percentage of cases (Dudgeon method).

Examination of the sediment of the aspirated pleural fluid will frequently establish the presence (and the inoperability) of malignancy (pleural).

The finding of distant metastases metastatic lymph nodes and certain clinical features may establish the inoperability at the same time as the malignancy.

Exploratory thoracotomy should be performed without hesitation in any case suspected of being pulmonary neoplasm. In expert hands in a good clinic an exploratory thoracotomy is no more serious than an exploratory laparotomy except in two conditions to be described under contraindications. Even if malignancy is not found at operation in a suspected case the existing disease is usually amenable to surgery (e.g. tuberculoma abscess benign tumor, cyst).

Aspiration biopsy done under a biplane fluoroscope often yields positive findings in otherwise doubtful cases. We do not use this procedure at our clinic unless we consider the patient is inoperable by virtue of age or poor condition. It is then performed for its prognostic value.

Contraindications to Operation—Signs of inoperability are those of metastasis either to distant parts or to a nearby part which cannot reasonably be resected. Thus paralysis of the left vocal cord (due to recurrent laryngeal nerve involvement) Horner's syndrome (due to mediastinal invasion and involvement of the stellate sympathetic ganglion) pleural effusion (especially if bloody) which rapidly recurs on removal evidence of metastasis to sternum or vertebra pericardial effusion (from pericardial invasion) esophageal obstruction (from direct invasion uncommon) and now less definitely phrenic nerve paralysis (high diaphragm) and rib destruction. These last two signs are somewhat less conclusive of inoperability recently since we do not

hesitate to contraindicate even a simple exploration. The first of these is marked distentions of the neck veins (indicative of serious superior vena caval obstruction) in a proven case of bronchiogenic carcinoma. These cases practically always show irremovable direct neoplastic invasion of the superior vena cava. Besides they have a great tendency to develop brain edema after operation. Thus the negligible mortality of simple exploration becomes appreciable in this type of case. The second is the presence of a very copious purulent expectoration in a case which is very likely to be inoperable from other evidences. Such a case will usually be found to be inoperable and then the patient will have to go through his anesthetic and postopera-

tends to recur rapidly after aspiration, and eventually becomes bloody. Sometimes it becomes bloody very early. Symptoms of mediastinal pressure (dyspnea, cyanosis, cough), bring the patient to the physician, (too late, of course). At other times the pleural involvement brings about early adherence of visceral and parietal pleura in the region of the lesion. The growth then extends into the chest wall involving muscles, bones and eventually nerves.

Symptoms.—The symptoms of bronchiogenic carcinoma are variable. Cough occurs in 75 per cent plus. Hemoptysis varying from spotting to frank hemorrhage occurs in 50 per cent. Deep pain in the chest, later pleuritic pain in the chest, change in character of chronic cough usually to a productive type, wheezing especially unilateral, shortness of breath perhaps evanescent, loss in weight, progressive anemia, and evidences of metastasis are of varying prominence. Sepsis (fever, chills, sweat) is present whenever infection occurs.

Diagnosis.—Diagnosis is still made too late, thereby destroying hope of cure in most cases. Clinical suspicion is our most valuable guide. As physicians come to realize the frequency of this disease and to suspect it in every case of cough continued over four weeks, and indeed in any person with evidence of respiratory infection of atypical course, we will diagnose bronchiogenic carcinoma more frequently in a curable stage.

The routine upright postero-anterior x ray pictures will show some departure from normal in about 95 per cent of cases, but is not always diagnostic. Lateral x rays may add a great deal of information and body section radiograms and bronchograms add even more. The presence of a wedge shaped shadow of atelectasis is in itself presumptive evidence of malignancy and almost pathognomonic of bronchial obstruction. A single oval or round mass in the peripheral lung field has been shown by Davis¹⁹ to be a malignant tumor in a high percentage of cases (72 per cent in over forty cases).

The exceptions are in those tumors situated in the upper lobe bronchus or superior division of the lower lobe bronchus. In the peribronchial tumors and in the peripheral ones, direct bronchoscopic visualization is impossible but even here information as to narrowing of the bronchus, encroachment by external pressure and widening or fixation of the canna (indicative of mediastinal metastasis) may be

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Bronchoscopy is a most valuable and definitive method of examination. In the endobronchial central type the bronchoscope can visualize the tumor in most cases, and a direct biopsy can usually be obtained. The exceptions are in those tumors situated in the upper lobe bronchus or superior division of the lower lobe bronchus. In the peribronchial tumors and in the peripheral ones, direct bronchoscopic visualization is impossible, but even here information as to narrowing of the bronchus, encroachment by external pressure, and widening or fixation of the carina (indicative of mediastinal metastasis) may be

reported positive findings in over 15 per cent of proven cases. Direct

noses have never been confirmed by tissue study. Of these 131 cases, exploration was done in eighty-six (65.6 per cent), and of them fifty-one cases (59.3 per cent of eighty-six) were subjected to pneumonectomy, two to lobectomy (2.3 per cent), and one to a segmental resection (lingulectomy) (1.2 per cent). Sixteen of these operations (18.6 per cent) were considered to be palliative at the time, including the lobectomies and the lingulectomy. There were seven operative (resections) deaths (13.9 per cent). At present nineteen of the patients treated by resection are still living, four of them over five years. In one of these five year "cures" there is evidence of metastasis, and in one the condition may really have been an "adenoma" at the time of operation. The other two seem to be real cures. Of the remaining fifteen living patients, three have evidence of metastasis, and four more underwent palliative resections (including one lobectomy and one lingulectomy). The other eight patients seem well, one of them now four years after operation.

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tive period of embarrassed expectoration in the presence of this overwhelming bronchial flooding Frank drowning, asphyxia, atelectasis and pneumonitis are extremely likely. It is now our policy, if we do explore in such a case, to perform palliative resection even if the disease is incurable, rather than to leave this suppurating lung in

tomy. Thus it may offer a chance of cure in a patient too feeble to stand a pneumonectomy. The consensus is that pneumonectomy is a better operation for cancer whenever feasible.

When it is obviously impossible to obtain a cure because of intra

ever we feel it will not unduly jeopardize the immediate operative recovery. Certainly the removal of an obstructed suppurating lung along with the primary lesion can scarcely help improving the patient's general condition. While good health may persist up to two or three years after such a palliative operation, the average patient shows evidence of recurrence in about a year.

In addition to an increased willingness among thoracic surgeons to perform more extensive operations for lung carcinoma with resection of portions of the chest wall, diaphragm or pericardium when necessary, there is an increasing tendency to enter the pericardium electively. This has been recommended by Allison²³ and by Healey and Gibbon²⁴ in order to ligate the pulmonary vessels at a greater distance from the site of the tumor. The intrapericardial portion of these vessels is muscular and tolerates ligation well. The opening of the pericardium probably adds certain hazards (e.g., arrhythmia, shock) to the procedure, but the old bugaboo of pericardial infection is apparently invalid. As long as the pericardium is left open it tolerates infection as well as the pleura. After ligating and dividing the vessels

is resected widely and removed with the specimen

pleural space should

my. We have vacil

lated a great deal. At the present time we avoid thoracoplasty after operations which we do not feel are curative. Thoracoplasty is done when we feel the patient is cured, and when he is young and vigorous enough to tolerate the procedure without risk.

During the period of 1940 to the present time, the senior author (C. P. B.) has seen, according to our records, 131 cases of clinically diagnosed cases of bronchiogenic carcinoma. Several of these diag

noses have never been confirmed by tissue study. Of these 131 cases, exploration was done in eighty-six (65.6 per cent), and of them fifty-one cases (59.3 per cent of eighty-six) were subjected to pneumonectomy, two to lobectomy (2.3 per cent), and one to a segmental resection (lingulectomy) (1.2 per cent). Sixteen of these operations (18.6 per cent) were considered to be palliative at the time, including the lobectomies and the lingulectomy. There were seven operative (resections) deaths (13.9 per cent). At present nineteen of the patients treated by resection are still living, four of them over five years. In one of these five year "cures" there is evidence of metastasis, and in one the condition may really have been an "adenoma" at the time of operation. The other two seem to be real cures. Of the remaining fifteen living patients, three have evidence of metastasis, and four more underwent palliative resections (including one lobectomy and one lingulectomy). The other eight patients seem well, one of them now four years after operation.

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VAGOTOMY FOR THE TREATMENT OF PEPTIC ULCER

JULIAN JOHNSON, M D, D SC. (MED), F A C S *
AND THOMAS E. MACIELLA, M D †

SUFFICIENT evidence has accumulated to indicate that certain abnormalities in the motor and secretory functions of the stomach exist in association with peptic ulcer. The chief of these abnormalities is the hypersecretion of hydrochloric acid by the stomach. The contact of this abnormally concentrated hydrochloric acid with the mucosa of the duodenum is probably the direct exciting factor in the etiology of duodenal ulcer.

The operation of pyloroplasty was designed with the hope that sufficient bile and pancreatic juice would regurgitate from the duodenum into the stomach to neutralize the excess acid before it came in contact with the duodenal mucosa. The procedure of gastrojejunostomy was used with the hope that the duodenal contents would pour into the stomach and neutralize the acid before it left the stomach. The results of these surgical procedures, designed to neutralize the high gastric acidity after it had been produced, were so disappointing that attention was turned toward preventing the formation of abnormal amounts of acid by surgical means. The operation of pylorectomy with repair by the Billroth I or II procedure was conceived with the thought that the trigger mechanism which controlled the secretion of hydrochloric acid was situated in the pyloric end of the stomach. There was a high incidence of recurrent ulceration following this operation. It was not until subtotal gastrectomy came into common use that there was a real change in the type of results achieved in the surgery of duodenal ulcer. By removing from two thirds to three fourths of the stomach the gastric acidity may be markedly reduced. That a major gastric resection has produced remarkable improvement in the surgical results cannot be doubted by anyone who has had the opportunity of following these patients over a period of years. The majority of them return to a normal diet and way of life. In a recent review² of 113 gastric resections done in this clinic and followed in the gastrointestinal section 90 per cent were considered to be complete cures. Of the 10 per cent failures in this series 5 per cent were due to intercurrent diseases and 5 per cent were accounted for by technical errors.

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on the basis of an inadequate resection (less than one half of the stomach removed or the pylorus left in) done during the early part of the series. Thus only two patients had recurrent ulceration in whom as much as two thirds of the stomach including the pylorus was removed. Wangenstein²³ who has insisted that three fourths of the stomach be removed in all cases has reported a series of 300 gastric resections with no recurrent ulceration.

Acting on the concept that hyperactivity of various functions of the stomach in patients with peptic ulcer might be due to impulses from the central nervous system through the vagus nerve supply Dragstedt⁶ revived the operation of vagotomy. He reasoned that the poor results obtained by the earlier workers in this field (Bircher 1921² and Pieri and Tanferma 1930⁸) may have been due to incomplete section of the vagus nerves. For Hartzell¹³ had shown in dogs that while bilateral vagus resection decreased gastric acidity this did not occur unless the section of the nerves was complete. Dragstedt and his associates^{7, 8, 9, 10} have subsequently extended their series of patients and the results from other clinics have been reported (Moore et al²⁴ and Grimson et al²⁵). The encouraging results in these clinics have led to the wider use of the procedure and at the same time have made it evident that the operation is sometimes attended by certain complications the most troublesome of which is gastric retention.

PHYSIOLOGICAL CONSIDERATIONS

It is a familiar clinical observation that peptic ulcer symptoms may be precipitated or made worse by periods of mental stress. The connection between the brain and upper intestinal tract was demonstrated by Pavlov who showed that following bilateral vagotomy in dogs gastric secretion in response to "sham" feeding and conditioned reflexes was lost. Stahnke³¹ was able to produce typical peptic ulcers in dogs by chronic electrical stimulation of the vagus nerves. Likewise Beaver and Mano¹ noted that their Mann-Williamson dogs did not develop ulcers if the vagus nerves were divided while the controls and those with the sympathetic nerve supply divided routinely developed ulcers.

Thus there was considerable background for expecting vagotomy to alter the abnormal physiology of the stomach in peptic ulcer patients. Clinical experience has now demonstrated that following complete bilateral vagotomy the ulcer patient is suddenly and dramatically relieved of his pain, there is a decreased volume and acidity of nocturnal gastric secretions, an absent response to "sham" feeding and an absent response to insulin induced hypoglycemia with little or no change in response to chemical stimulants such as histamine or caffeine. Needless to say a complete section of the vagus nerves must be done to produce this type of reaction. This has now been demon-

strated in patients just as Hartzell¹³ demonstrated it in dogs in 1929

McCrea²⁰ pointed out that section of the vagus nerves above the diaphragm produced marked motor effects on the stomach of the experimental animal. This has been confirmed repeatedly in humans and has accounted for one of the most troublesome complications of the procedure

It has been of interest to us that in the operation for carcinoma of the esophagus when a resection and esophagogastrostomy is done, both vagi are cut, yet in ten such patients operated upon by us re-

lesion at the pylorus is not likely to produce gastric retention

The exact status of the pylorus following complete vagotomy has not been determined. Likewise, the question has arisen as to whether or not harmful effects might be produced on the rest of the gastrointestinal tract. The vagus does supply parasympathetic innervation down to the proximal half of the transverse colon, and, indeed we have observed apparent atony of the small intestine which responded to urecholine for about ten days in one patient following supra diaphragmatic vagotomy.

Whether or not the effects of vagotomy will be permanent depends upon whether there will be regeneration of the parasympathetic nerves or whether the remaining mechanisms will compensate in some way for the absence of the vagus innervation. In follow up observations on Hartzell's dogs Vanzant³⁴ revealed that though the reduction of acidity 1 two or three indicate a

secretion to return to the preoperative level within a year following bilateral vagotomy in their patients. These observations obviously cast considerable doubt upon the lasting benefits of vagotomy for duodenal ulcer. Further studies will have to be made in the way of long term follow ups

OPERATIVE PROCEDURE

Vagotomy may be done either from above or below the diaphragm. In his original paper Dragstedt⁶ suggested the supradiaphragmatic approach but later⁸ changed to subdiaphragmatic operation in order to be able to perform a gastrojejunostomy at the same time. Bradley and his associates³ studied the branches of the vagi in ninety two autopsies and concluded that vagotomy could be done with equal probability of success whether above or below the diaphragm. They

the other hand felt that the supradiaphragmatic approach with careful elevation of the esophagus from its bed would permit a better chance of complete section

From the standpoint of the ease of the procedure we prefer the supradiaphragmatic operation. However, because of the complication of gastric retention which often follows the procedure we now feel that the subdiaphragmatic operation with an accompanying gastrojejunostomy or resection is preferable. By either approach it seems unlikely that a complete division of the nerves can be attained in 100 per cent of cases. Walters³⁴ found the vagotomy to be complete in 80 per cent of his series. Dragstedt¹⁰ has not reported the incidence of incomplete section in his series but has reoperated upon sixteen of the first 200 patients to divide more nerve fibers.

When vagotomy is being done as a secondary procedure because of marginal ulcer after a gastric resection or gastrojejunostomy the supradiaphragmatic approach would seem to be preferable.

Our series has been small including only eighteen vagotomies

<i>Supradiaphragmatic</i>		
Uncomplicated		6
Previous gastrojejunostomy		2
Previous gastrectomy		1
<i>Subdiaphragmatic</i>		
Uncomplicated		4
With gastrojejunostomy		3
With gastrectomy		2

In addition to these one of us (T E M) has had the opportunity of studying two patients who had vagotomies done elsewhere.

INSULIN TEST

While at the time of operation it is difficult to determine whether or not the vagus nerves have been divided in their entirety this may be ascertained during the postoperative period by means of the response of gastric secretion to the hypoglycemia induced by insulin.^{27, 18, 37} Some clinics using the test have not been impressed with its reliability but we have felt that if proper care is taken to control all variable factors the test will prove to be satisfactory in most cases.

The tube should be placed in the stomach under fluoroscopic guidance and its position checked especially after the insulin has been administered. The patient should not be allowed to swallow saliva and he should not have had atropine or allied drugs for some time prior to the test. The test is not very applicable to diabetics. Gastric secretion should be collected by continuous aspiration. Unless constant suction is employed a large amount of gastric content may enter the duodenum during the period of insulin induced gastric motility.

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It has been of interest to us that in the operation for carcinoma of the esophagus when a resection and esophagogastrostomy is done both vagi are cut yet in ten such patients operated upon by us recently none have had gastric retention and it has not been a problem in the series reported in the literature. This would suggest that vagotomy in the absence of a duodenal ulcer or some other pathological lesion at the pylorus is not likely to produce gastric retention.

The exact status of the pylorus following complete vagotomy has not been determined. Likewise the question has arisen as to whether or not harmful effects might be produced on the rest of the gastrointestinal tract. The vagus does supply parasympathetic innervation down to the proximal half of the transverse colon and indeed we have observed apparent atony of the small intestine which responded to urecholine for about ten days in one patient following supra diaphragmatic vagotomy.

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to the abdominal approach in order to be able to do a gastroyejunostomy at the same time

In any event we would like to point out that gastric retention is a very troublesome complication from the standpoint of the patient. Since it is not possible to predict with certainty which patients will have retention we believe that if vagotomy is to be used as the primary treatment for duodenal ulcer, a gastroyejunostomy or resection should be done at the same time. If we allow many of these patients to suffer from this very annoying complication, we shall bring into disrepute a procedure which otherwise may turn out to be a valuable adjunct to surgery.

As the result of the interference in gastric motility the morbidity of this operation has been far greater than that of gastric resection. Gastric resection for ulcer has become so common in most large clinics that the morbidity has been reduced to a minimum. We usually have a tube in the stomach for twenty four to forty eight hours and then start the patient on fluid by mouth with a very rapid increase in the diet thereafter. These patients are usually discharged from the hospital in from eight to twelve days taking a soft diet. Any difficulties in gastric emptying after gastric resection alone are uncommon.

While gastric retention following vagotomy usually occurs during the immediate postoperative period it may occur late subsequent to the healing of the ulcer with the production of a scarred stenotic duodenum. Moore and his associates²⁴ reported one such patient in whom the stenosis became severe about nine months after vagotomy.

Diarrhea—Diarrhea has not been observed by us in any of our postvagotomy patients. We have had one patient however, who formerly suffered from severe constipation and now is very much pleased that he has two to three bowel movements a day. Grimson²⁴ found 6 per cent severe persistent diarrhea in 360 personal and collected cases. One of us (T. E. M.) has had occasion to study a patient with diarrhea operated upon in another hospital.

The etiology of the diarrhea has given rise to a great deal of speculation. Studies of enzyme concentration in the external secretions of the pancreas in the patient observed revealed no deficiency in amylase, lipase or trypsin. Analyses of the stools for total neutral and split fats while the patient was on the Schmidt diet revealed no deficiency in the splitting of fat. The percentages of total fat are high indicating impairment of fat absorption.

Difficulty in Swallowing—Difficulty in swallowing has not been observed by us following vagotomy but Grimson and his associates¹⁸ observed a transient difficulty in twenty one of fifty six patients. In a few of them the symptoms persisted up to four to seven months but with decreasing severity. They attribute this to spasm of the esophagus as the result of losing its parasympathetic innervation.

The regurgitation of duodenal content into the stomach can, to a large extent, be prevented by simultaneous intubation of the duodenum and stomach and collecting the content of these two structures separately. After collecting three basal fifteen minute fractions, 16 units of regular insulin are given intravenously. The collection of fifteen minute fractions is continued. Within thirty to forty five minutes in nondiabetic individuals with vagi intact there occurs an in-

when the test is repeated

COMPLICATIONS

Gastric Retention.—Gastric retention is the most troublesome complication following vagotomy. When it occurs, the patient has repeated vomiting of retained food. This usually has a foul odor because of hav-

long, and after a few weeks there was adequate emptying of the stomach. In others there was serious interference with the patient's nutrition, and a gastrojejunostomy had to be done^{7 8 11 12} or the patient carried along on medical therapy to promote gastric emptying^{13 14 15}

month period she had intermittent bouts of nausea and vomiting every time she tried to get along without urecholine. She often had nausea, foul eructations and occasional vomiting even while on the drug.

The third patient has been kept relatively symptom free with urecholine for ten months but still has no return of motility or spontaneous evacuation.

We have observed transient retention in five other patients, both with and without gastroenterostomy, but they were kept comfortable by the use of urecholine during the period of retention and now get along without it.

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RESULTS

Recurrent Ulceration.—This procedure is too new to evaluate it from the standpoint of persistent or recurrent ulcer in a long term follow up. However, it is apparent that ulceration is recurring even in the presence of negative insulin tests. Colp³ reported a patient whose ulcer failed to heal even though two insulin tests indicated that the vagotomy was complete. Walters and his associates²⁶ has had six ulcers which failed to heal or recurred in spite of negative insulin tests. One patient perforated a duodenal ulcer two weeks following vagotomy. Smith and his co workers³⁰ and Moore and others²⁴ have reported recurrent ulcers following vagotomy. Dragstedt,⁹ on the other hand, states that in no instance in his series of two hundred and seventy vagotomies did complete vagotomy fail to reduce the excessive gastric secretion to normal. He thereby inferred that he had no recurrent ulceration following complete vagotomy but he did not say so specifically. As might be expected there have been numerous instances of recurrent or persistent ulceration in patients in whom the vagotomy was incomplete.

About eight months after operation he had a return of ulcer symptoms and x ray again revealed an ulcer crater. The test to insulin is still similar to that obtained immediately after vagotomy.

This patient illustrates Walters' statement²⁶ that immediate relief of the ulcer pain and motor disturbance may occur whether or not the vagotomy is complete.

It can, of course, be contended that all the patients who experience recurrences or persistence of their ulcers have had incomplete vagotomies and that the insulin tests are not reliable. Be that as it may, it seems quite likely that the percentage of incomplete vagotomies will exceed the percentage of recurrent ulcer following high gastric resection. It may be that as time goes on the technic of doing a complete vagotomy will improve, but because of the anatomical considerations it seems probable that there is more chance of the average surgeon learning to remove two thirds to three fourths of the stomach than of his being sure he has done a complete vagotomy.

If, on the other hand, the insulin test can be relied upon and if the above reported recurrences have taken place in spite of a total vagal

section, grave doubt is cast upon the fundamental basis of this operation. Perhaps regeneration of the parasympathetic nervous system does occur or some other mechanism takes over its function. This is suggested by the work of Moore and associates²⁴ who found that in patients with complete vagal sections the night gastric secretion and gastric tone returned to the preoperative level in about a year. This is in general agreement with the observations of Vanzant²⁴ on Hartzell's dogs. If these observations be correct, long term follow up will probably find a high incidence of recurrent ulcers. Time along with careful follow up studies will answer this question.

The Place of Vagotomy at the Present Time.—It seems to us that vagotomy in the treatment of peptic ulcer while possibly based on

gastric ulcer because of the well known difficulty of ascertaining the presence of malignancy in such a lesion. We feel that when vagotomy is used in the treatment of duodenal ulcer, an accompanying gastrojejunostomy or resection should be done in all cases because of the difficulty of determining which patient may develop retention.

Vagotomy should not be used as an emergency or semi emergency procedure. Certainly it is expecting too much of it to use it as a treatment of bleeding ulcer. Moreover, we feel that the patient who has just stopped bleeding and becomes stabilized should be subjected to gastric resection with removal of the ulcer rather than be treated by vagotomy, for fear that the bleeding may start again.

The foremost indication for the experimental use of vagotomy at the present time would seem to be the patient who has already had an inadequate gastric resection or a gastrojejunostomy and has developed recurrent ulceration. Moreover, there is the occasional patient who has had what we ordinarily consider to be an adequate resection (two thirds) and develops recurrent ulceration. It is a much simpler procedure to do a supradiaphragmatic vagotomy on these patients than to resect more of the stomach. Since the patient already has a functioning stoma which will not have postoperative edema, there should be little or no difficulty with postoperative retention.

SUMMARY

1 High gastric resection is still the treatment of choice for the usual peptic ulcer patient who comes to surgery. When an adequate gastrectomy is done (two thirds to three quarters), we believe excellent results may be anticipated in approximately 95 per cent of the cases.

2 Bilateral vagotomy as a treatment for duodenal ulcer, while apparently based upon sound physiological principles as to the immediate results should be considered an experimental procedure until

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MODERN TECHNICS IN COLON SURGERY

JOHN CARNETT HOWELL, M D, F.A.C.S *

FAILURE to recognize the presence of colon growths arises largely from lack of understanding that, in obstructive lesions, the patient's symptoms are usually referred to the upper abdomen, with epigastric distress during the meal or shortly thereafter. If the patient has a hernia, the maintenance of reduction is more troublesome because of increased intrabdominal tension associated with loss of weight. Consequently, we see hemorrhaphies and cholecystectomies frequently done within the year before the large bowel growth is recognized in the late stage of the disease. Again when the patient is first seen by a physician for acute large bowel obstruction, cleansing enemas are ordered and soon afterwards a flat plate (survey) roentgenogram is made. Confusing findings occur on the film so that some of the errors of diagnosis occur at this stage. If the patient has been unsuccessful in having a normal bowel movement for three days or more, is suffering from crampy abdominal pain and has "bubbling" or increased peristalsis, a skiagram is not necessary for management of the problem. Death from peritonitis by reason of perforation of rectosigmoid or sigmoid has occurred from enemas to relieve obstruction or for diagnosis. Deaths have also occurred from delay in relieving large bowel obstruction until the cecum has spontaneously ruptured. The cecum is the commonest site for rupture of the bowel in left colon obstructions due to intrinsic lesions.

Acute obstruction of the large bowel then affords us the commonest cause for surgery. By acute obstruction is meant the sudden onset of inadequate or absent bowel movement, failure to pass flatus, abdominal distention frequently associated with nausea and vomiting (24 to 36 h

pains
rise in temp . . .
ent on the patient's muscular tone and not his age. A 30 year old asthenic may be slower in developing these symptoms than a farmer twice that age.

We prefer general anesthesia in intestinal obstruction because the anesthetic agent does not disturb the normal innervation of diseased bowel and, since exploration is contraindicated under the circumstances, the necessity for abdominal paralysis is not desired.

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CECOSTOMY

Cecostomy is the safest and most reliable procedure for immediate relief of acute left sided colon obstructions because (1) the site exposes the most likely point for spontaneous perforation, (2) it does not interfere with subsequent resection of the offending lesion and (3) it permits adequate peritoneal drainage if necessary. Cecostomy has the disadvantage of not defunctioning the colon as efficiently as the transverse colostomy.

The approach to the peritoneal cavity in cecostomy is made through the McBurney incision and the peritoneal cavity is protected from contamination by gauze sponges. If the cecum is not mobile it becomes so by cutting the lateral leaflet of the peritoneal covering along the axis of the bowel to an extent that will permit the bowel to come up freely into the wound. A purse string suture of linen encircles 0.5 cm. of the anterior bowel into the center of which an 18 gauge needle attached to the suction apparatus is thrust. After the gas and thin liquid of the cecal contents are aspirated as much as possible the ends of the purse string are drawn taut for tying the first knot which is completed as the tip of the needle leaves the serosal covering of the bowel. A curved Scudder clamp can then be applied across the base of the cecum which can be re-aspirated. Another purse string of linen can be inserted with sufficient diameter of the anterior wall enclosed to permit a crucial incision for the delivery of a glass Paul right angled tube. An effort should be made to invert the serosal margins so that the linen suture will grasp snugly the wall of the Paul tube between its first two flanges. Two additional purse strings of the same material are placed to increase the inversion of the bowel above the second flange. The rubber connecting tube attached to the

extension tubing are clamped. If exudate resulting from a peritonitis is encountered about the cecum and the pelvis the liquid portion is aspirated and cultured. For drainage we prefer split soft rubber tubing whose lumen contains a fine gauze wick. Drainage is established with three such tubes: one from the cul-de-sac, a second from the base of the cecum, and a third along the lateral gutter of the ascending colon. The parietal peritoneum is closed with continuous chromic catgut sutures to approximate it about the Paul and other tubing if present. The remainder of the abdominal wound is packed loosely with gauze saturated with 5 per cent dichloramine T.

This method of cecostomy deflates the intestinal tract overnight and as in no other form of colostomy the suture line about the Paul tube may remain water tight as long as seven days.

Irrigation of the ascending colon through the Paul tube may be done on the first postoperative day using 2 ounces of normal saline

solution at hourly intervals, if necessary, to remove dried thick boluses of feces. Ordinarily we do not irrigate the distal colon until the fifth postoperative day, using 1 to 2 quarts of saline solution.

Cecostomy or colostomy militates against the effectiveness in the intestine of nonabsorbable sulfones administered by mouth. Oral administration of sulfones must necessarily be supplemented by parenteral administration of streptomycin or penicillin before future resection is done.

Cecostomy wounds, like those of ileostomy, close spontaneously if the obstruction to the distal colon and rectum is removed and if its mucosal line is covered with a sufficient bed of healthy granulations.

Closure of a Cecostomy.—Closure of a cecostomy should never be attempted unless the obstruction of the natural outlet of the colon and rectum is relieved. If the mucosa unfortunately lies too near the abdominal skin, surgical repair of the fistula is necessary.

Before the final draping and painting of the skin preparatory to closure, dry gauze packing is loosely inserted in the cecostomy outlet to prevent intestinal contents from flowing into the wound and contaminating the field.

The original McBurney wound is now reconstructed at its lateral and mesial corners first to expose the external oblique muscle and its aponeurosis. Next the skin about the cecostomy is removed by an elliptical incision, discarding the skin attached to the margins of the

internal oblique and transversalis muscles and fascias are treated likewise. When freeing the transversalis fascia from the margin of the cecostomy, the parietal peritoneum is apt to be opened near the rectus muscle. Sufficient bowel wall for suture closing has been delivered by this stage so that this step can be taken now. Any indurated or fibrosed bowel is trimmed away. A swedged intestinal needle, to which is attached chromic No. 0 catgut, is used. We prefer straight needles as the curved swedged needles are too flimsy and prolong the

chromic gut is now inserted in like manner except that every third suture is locked. The attachment of the parietal peritoneum is next divided with care not to injure any of the adherent bowel in the immediate vicinity at this time.

For postoperative drainage of this contaminated area a stab wound is made in the layers of the transversalis, internal oblique and external oblique are

approximated with chromic No 1 catgut on a Mayo needle. The skin is finally closed. As a rule, postoperative chemotherapy is continued for five days. The gauze packing inserted into the lumen of the bowel at the first step of the operation may be left in if the fecal contents keep spilling into the wound.

Interim Management.—After surgical drainage of the bowel has been established, search for the level of the colon obstruction should be made with proctosigmoidoscopy and barium enema roentgenogram study. This interval of time is used to reestablish blood volume and electrolytic loss. Because of local conditions, two to four weeks are necessary to prepare the patient for subsequent surgical exploration and treatment. We rely greatly on blood replacement, preoperative irrigations, and chemotherapy. Before the operation, at the time of proctosigmoidoscopy, digital examination is important for two sources of information. First, we desire to know whether the anal sphincter is tight, a common finding, and secondly, whether perirectal masses are felt anteriorly below Douglas's cul de sac. It is necessary to dilate a tight anus as part of the anastomosis operation while the patient is under the anesthetic. Obviously, the manual dilatation can be more complete if general anesthesia is used because spinal anesthesia temporarily paralyzes the sphincter muscle.

SINGLE STAGE COLONIC RESECTION AND ANASTOMOSIS

Types of resections are divided into immediate and multiple staged procedures.

Immediate resection and anastomosis is usually possible for two common lesions, carcinomas of the cecum and papillomatous adenomas of the left colon. These lesions seldom present the complication of intestinal obstruction. For the right colon lesions we therefore employ resection of the terminal ileum, cecum, ascending and proximal half of the transverse colon with end to end anastomosis of the ileum to transverse colon. From my own observation, fewer complications occur in this procedure because of the shorter time required and, at the same time, less suturing. To gain more circumference of the small bowel, it should be cut on the bias with the longer side—the mesenteric.

A modified muscle splitting gridiron incision carried medially to permit division of the lateral portion of the rectus sheath so that the rectus abdominis can be retracted medially is the preferred wound for right and left colon resections. The incision permits ample exposure, if properly made and does not necessitate division of nerve supply to any of the abdominal musculature. Again, small bowel is easily packed off with much less handling of peritoneum. Quicker restoration of diaphragmatic breathing occurs with this type of wound and no fear of dehiscence is attendant. Best of all the patient can be ambulatory earlier with less risk.

Caution to expose the duodenum and the right ureter without damage to those structures is paramount. If the liver, celiac and aortic nodes are not grossly involved with metastases and if the primary growth has not directly extended to become fixed to the retroperitoneal structures, the resection is carried out. Incision of the posterior parietal peritoneum from the cecum up above the hepatic flexure permits mobilization of the right colon and cecum. This incision then swings mediad and divides the gastrocolic and hepaticocolic "ligaments." The dissection is carried mediad to expose all of the lymph nodes apt to be involved by lymphatic embolism. The exposed right colic and branches of the midcolic vessels are clamped and divided. They are ligated individually with chromic No. 1 catgut and the ileocecal vessels are divided and ligated when splitting the mesentery for removal.

A Bartlett-Bates intestinal anastomosis clamp is placed to grasp the ileum at a level which permits its delivery without tension to the mid transverse colon. The latter structure, too, is likewise clamped. The Payr clamp is placed across the ileum on an angle to permit the cut surface of the gut to equal the circumference of the colon to be approximated with care that the longer side of the ileum is on the mesenteric surface.

The suturing of the anastomosis calls for the "open technic." Therefore, before mucosa is exposed by excision, careful placing of protective sponges is accomplished by putting one under the center bar between the approximated loops and four about each end of the forceps so as to cover the ends of the instrument as well. During the insertion of the outer row on the posterior row of linen sutures, instruments only grasp the needle and suture material. A continuous Cushing stitch, every third one being locked, is applied from one end to the other. A second (inner) row of sutures of chromic No. 0 catgut on an atraumatic needle is then made in plain whip over style from one to the other to lock each stitch. The same suture is continued about the corner onto the anterior surfaces of the approximated edges. Each of these is locked on the mucosal side so that, starting there the needle passes through all coats of the bowel $\frac{1}{8}$ inch back from

ends of the suture are tied triply and again to the end of the locking catgut stitch left long for that purpose. The outer layer of Cushing releasing the outer bars

the peritoneal field are discarded and all hands change gloves and gowns. Fresh towels are placed and the wound closure is commenced.

One of the most offending breaks in the technic of the open type

of intestinal resection is the failure to discard immediately all sponges and instruments which have been contaminated by touching the exposed mucous membrane

Before completion of anastomosis, two requisites are to be satisfied. One is that the aperture is sufficient after suturing to permit the ends of the thumb and index fingers to pass up to the first knuckles, the other is that the intestinal lumen can be

Any area which is not properly inverted tightly should be immediately oversewn. The cut edges of the divided mesentery and mesocolon are drawn together with a continuous catgut suture with great caution not to penetrate or include any of the main arcuate vessels. A separate mattress suture at the mesenteric border of the bowel seals this angle and the overlying cuff of mesentery is overlapped to further insure the closure.

Many patients are not good risks for intestinal intubation. Obstructive nasal passages, chronic nasopharyngitis, bronchiectasis, chronic tracheobronchitis, intercostal myasthenia and lowered vital capacity are some of the contraindications to intubation. In such individuals a temporary colostomy tube threaded through the anastomosis and 4 inches beyond is desirable to decrease postoperative complications. The tube is withdrawn after normal bowel function is established for three or four days and the wound spontaneously heals in a week's time. Such surgical drainage of the bowel should always be made through a stab wound to prevent contamination of the main wound of approach.

When it is necessary to resect only a small portion of the left colon to remove a solitary benign bleeding papilloma, the one stage resection and end to end anastomosis is performed. The same preoperative care for correction of blood loss, dehydration and malnutrition is employed. The "aseptic" closed method of Parker and Kerr has not given us the same uniform good results as the open suture technic. More suture leaks on the fifth or later postoperative day have occurred with the former method. It is my personal feeling there is too much bowel inverted with the Parker Kerr method. With both types of resection it is necessary to preserve the blood supply to the distal segment. This precaution in obese mesocolons requires exposure of the left colic artery and

as previously described. The wire sutures for serosal to-serosal

patients and, although an old procedure, it is urgently advised in spite of the blissful sense of security growing among surgeons in this age of excellent chemotherapy. I have not had any experience of exteriorizing an anastomosed loop of colon because I have yet to find a case suitable for such a procedure.

Resections of colon growths are indicated when the lumen is encroached upon by annular or near obstructing lesions even though metastatic liver disease is present. In one of our cases which clearly demonstrated the wisdom of this judgment, operation was done by the late Doctor J. B. Carnett in 1930 for carcinoma of the descending colon with half a dozen metastatic nodules palpated on the surface of the liver. The patient was a middle aged widow who had to support four children by the income earned as a school teacher. She returned to her full duties and, for seven years thereafter to our knowledge, she was in good health and fully able to continue in her same wage earning capacity.

MULTIPLE STAGE RESECTION AND ANASTOMOSIS (RANKIN MIKULICZ)

The original four stage Mikulicz resection seems to be outmoded and is now supplanted by Rankin's modification so that it is a three stage procedure today. It holds a prominent place in the treatment of those individuals whose disease presents pericolic extension associated with abscess, cellulitis or tumor in another viscus. The splenic and sigmoidal areas of the colon present interesting diagnostic problems. Suffice it to say that pericolic abscesses are most common in these two locations whether from primary carcinoma of the bowel, perinephritic abscess, diverticulitis or secondary to pelvic tumors. Resection of the colon is often required under these circumstances so that the Mikulicz teaching that the peritoneal cavity and the bowel lumen must never be open simultaneously must be strictly followed.

In performance of the Rankin Mikulicz resection, several demands must be met. The width of resection is dependent on the amount of

the peritoneal cavity must never be open

Obviously the segments of bowel perforating the abdominal wall must rest there without tension to retract below the abdominal musculature. We urgently protest against any sutures in the bowel wall in the presence of obstructed colons. Tying appendages together to approximate the loops for the construction of the spur will suffice in the presence of obstruction. When obstruction is absent, the spur can be made by suturing the longitudinal taenia together.

The obliteration of the spur (second stage) must not be done hurriedly in the sense that it is crushed away. The term "spur crusher" has played a role in this false idea. The purpose of the instrument is to produce necrosis of the spur by a gradually increasing pressure until the local blood supply is obliterated. The instrument should be so constructed that it can be inserted each blade singly to permit a palpating finger to pass down through the other stoma and determine if adjacent small bowel has slipped up between the curved segments of the colon making up the spur. In this manner the blades can be approximated without causing injury to the small bowel and consequential peritonitis. The blades male and female of the instrument should make even pressure through their entire length. For this reason instruments with a pivot joint are worthless and may be injurious. Those which are approximated on threaded bar by nuts best answer these problems.

The third stage of the Rankin Mikulicz resection is carried out by the same technic as described for closure of cecostomy.

LOOP OR PERMANENT COLOSTOMY

Loop or permanent colostomy for obstructed or ulcerated irresectable lesions of the rectum or sigmoid is occasionally necessary. It should be placed at a sufficient distance from the iliac crest to permit the outer rim of a colostomy bag apparatus to lie between the colostomy stomas and the bone. It should be high enough on the abdomen so that the patient can inspect it readily for cleansing purposes. A McBurney incision in the left lower quadrant of the abdomen is the choice. The loop of sigmoid and mesosigmoid selected should not contain gross carcinoma. It should be sufficiently long that it protrudes above the skin with the marginal vessel resting on the skin without tension.

Frequently the mesosigmoid is too short to fulfill the above requirements. By incising the lateral sigmoid along the long axis of the bowel the loop can be made sufficient to protrude freely above the skin level. Assuming the sigmoid could not be sufficiently mobilized a transverse colostomy is then in order.

Occasionally the mesosigmoid is too long and it is desirable to preserve the segment of the bowel to permit absorption of liquids for passage of well formed stools. The mesosigmoid is then shortened by plicating it with a series of chromicized catgut sutures placed in a purse string manner. In all cases of permanent loop colostomies the mesosigmoid must be sutured to the parietal peritoneum in the lateral gutter to prevent a knuckle of ileum descending through that space into the pelvis and thus becoming obstructed. We have seen three such complications months after colostomies in which this precaution was not taken. One of the recent cases had the small bowel adherent and obstructed in a ventral hernial sac about the colostomy site.

The colostomy loop is held suspended above the skin level by a

glass rod (such as muddler) whose ends are connected by a loose piece of rubber tubing passing over the exteriorized bowel. No sutures are allowable between the parietal wound and the bowel wall. The aponeurotic layers of the abdominal musculature must be approximated with sufficient play about the bowel that postoperative edema or abdominal distention will not permit them to necrose the bowel wall. That error in technique has been a cause for peritonitis or grade C wounds. The exteriorized bowel should be inspected for cyanosis after wound closure. If it is present, sutures must be loosened in the abdominal wound.

Surgical drainage of the exteriorized loop can be immediate after closing the skin and protecting the freshly repaired wound by petrolatum gauze, by using a purse string of Pagenstecher linen in a circumference that will permit a crucial incision on the anti-meso portion of the bowel loop through which the first flange of a Paul tube can pass to be anchored by the ends of the first purse-string tie. Further inversion can be made by two succeeding purse-string sutures of gradually increasing diameter. These latter two are knotted about the Paul tube above the second flange.

Unless obstruction compels surgical drainage through the loop division of the loop down to the level of the underlying glass rod is deferred until the fifth postoperative day. It can be elected to do this transection on the third postoperative day or thereafter. Inspection of the viability of exteriorized bowel must be carried out daily until the loop is divided. Since this operation is often performed in debilitated and elderly people, a review of the daily temperature pulse and respiratory rate record is not sufficient to reveal serious complications such as peritonitis or wound infection.

REPAIR OF TRAUMATIC PERFORATIONS OF THE COLON

Traumatic perforations of the colon have occurred in our experience only from external wounds of violence with the exception of course of those blown out at a necrotic area by enemas or those occurring at a postoperative suture line. Most of the perforations have been due to gunshot wounds. The problem of their management is presented by the associated damage to the blood supply as well as the actual perforation. Because of other associated perforations of viscera bone and hemorrhage the surgical shock must be overcome prior to repair of the bowel. There is lack of time from the standpoint of the patient's welfare, to permit resection and anastomosis under these circumstances. The procedures used may be anything from a simple colostomy through a solitary perforation to a Rankin-Wiklund resection after ligation of the injured vascular tree. Speed is paramount and whatever can be done most quickly to control bleeding prevent gangrene and diminish peritonitis is left to the judgment of the surgeon. Certainly it has never fallen to my lot to permit resection

anastomosis in gunshot perforation of the colon I have yet to see colon perforation without small bowel, bladder or gastric perforation at the same time

Traumatic perforations, some recognized immediately, and others not, occur during the course of extensive pelvic operations—hysterophorectomies. If the perforation occurs in the rectosigmoid area, I advise immediate repair after dividing the pelvic peritoneum anteriorly and laterally so that the repaired bowel is then covered by the constructed peritoneal flaps and external drainage is by the extra peritoneal route through the ischiorectal space or the vagina (near the posterior fornix). All such cases require a temporary sigmoidostomy through a No. 28 F. catheter or rectal tube inserted in classical Senn-Stamm technic through a stab wound in the left lower quadrant of the abdomen. Transperitoneal drainage of the pelvis is also required.

When the perforation is delayed or recognized during the post-operative period, transperitoneal drainage of the pelvic abscess is made with the end of the tube $\frac{1}{4}$ inch, if possible, from the source of the fistula. That tube is sutured to skin of the drainage wound and allowed to remain untouched except to see that its lumen is kept open by applicators. A Devine defunctioning colostomy on the transverse colon is in order after changing to fresh gloves, drapes and gowns when the pelvic drainage has been inserted. The drainage tube to the proximity of the rectosigmoid perforation is not shortened for at least ten days after its insertion, and then only if there is decrease in discharge of exudate for two successive days previously and the septic course of the patient is on the wane. The tube should not be shortened more than $\frac{1}{2}$ inch on each occasion. It can be twisted at daily intervals if necessary to prevent its adherence to peritoneum. After the pelvic abscess has been drained dry and exudate has not been seen for two months the transverse colostomy can be closed.

MISCELLANEOUS

Fecal Fistula—The causes of fecal fistulas are as follows: (1) a tract which is too short, (2) a tract which is too long (as just mentioned in the case of pelvic abscess originating from perforations in the rectosigmoid area), (3) obstruction of natural outlet, (4) malignant tumors, (5) specific and granulomatous infections, and (6) foreign bodies. Treatment of fistulas requires the eradication of these causes utilizing the various techniques already described.

Staging of pelvic lymphatics—In colon and rectal surgery for cancer, more, rather than less, radical dissection of the pelvic lymphatics is

required and it is unsafe to perform that treatment for primary lesions at the level of the lower sigmoid and distal without ligating the inferior mesenteric artery at its junction with the superior hemorrhoidal. Finally, there is nothing to add more to a patient's discomfort than a perineal colostomy discharging liquid contents.

Review.—The technical problems created by the disturbance of physiology because of variable types of pathology have been reviewed. Other sources of literature, such as the works of Rankin, Parker, Kerr and Devine, give more detail for their own procedures and, therefore, repetition is not necessary. More improvements can be foreseen in colon surgery, such as the Russian technique of using the transverse colon to supplant the resected portion of the esophagus, or, perhaps, anastomosis of arteries and veins may be made possible to lessen the necessity for colostomy, but such is not practical as yet. To give the patient the best opportunity to be freed of his disease, the sound principles of Mikulicz, Rankin, Wangenstein and Lahey must be studied and the surgeon utilize those giving the best results in his hands.

THE SURGICAL MANAGEMENT OF ULCERATIVE COLITIS

L. KRAEER FERGUSON, M.D.* AND ROBERT F. WELTY, M.D.†

CHRONIC ulcerative colitis still remains a disease the primary treatment for which lies in a carefully regulated medical regimen. However, in a considerable group of these cases such treatment fails and the only hope of relief lies in surgical intervention. This group constitutes about 25-30 per cent of all cases in which treatment is attempted and it is with these cases we are primarily concerned in this paper.

The etiology of ulcerative colitis is not understood though contributing factors such as the emotional make up of the patient are recognized. No single bacterial agent has consistently been isolated in all cases as it is possible to do in a specific enteritis such as typhoid fever. It is not surprising therefore that chemotherapeutic and antibiotic agents have generally failed to produce dramatic cures. For many patients who have shown improvement with the administration of these agents the relief is only temporary and must be attributed in part at least to the natural course of the disease which is one of remission and relapse. Others may improve after chemotherapy because of the influence which these agents have on any ulcerated surface which is secondarily infected. For this latter reason chemotherapeutic and antibiotic agents may be of value in the management of ulcerative colitis either in attempting to control the disease by medical management or in preparing the patient for operation if conservative treatment fails.

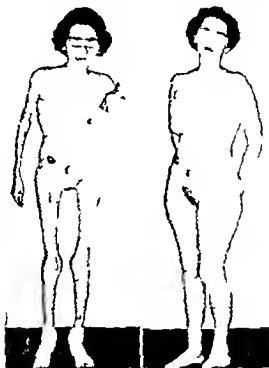
The length of time which one is justified in spending in attempting to bring the disease under control by medical means cannot easily be set down in figures applicable to all cases. Ileostomy is still considered with disfavor by most patients and by many of their physicians. The alternate which faces a patient seriously ill with this disease and not responding to treatment is even worse; however, ileostomy should no longer be considered as a measure of desperation in these cases. It is not fair to subject a patient to a long period of suffering and disability with permanent damage when a relatively simple procedure can afford him relief. Nor is it fair to the surgeon

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to present him with a desperately ill and moribund patient and expect him to perform miracles in resuscitation

INDICATIONS FOR SURGERY

The usual indication for surgical intervention is failure of the patient to show satisfactory improvement on an adequate medical program. Just what constitutes satisfactory improvement must be determined in each case individually. There should, however, be return



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lead an essentially normal life. The patient who is a child who has to stay within running distance of the bathroom who is unable to carry on his social or economic life is not considered a satis

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factory medical cure, even though he has no fever, and no blood or pus in his stools (Fig 423)

In addition to the usual indications for ileostomy, there are certain complications of the disease locally which may require urgent surgical intervention. With prolonged disease leading to much destruction of the bowel and replacement by scar tissue, obstruction of the lumen may ultimately result (Fig 424)

So much destruction of the bowel may take place in severe cases that the wall is eroded through completely and free perforation takes place. This catastrophe usually occurs in a patient who is critically ill with a fulminating type of the disease and the mortality is close to



Fig 424—Specimen of colon showing extensive disease of the entire large bowel with relatively little mucosa remaining. The abrupt cessation of the disease at the ileocecal valve is shown at top. Bottom loop is sigmoid where submucosa is covered in spots by mucosa.

100 per cent. If the perforation occurs only slowly, walling off of the area may occur and a localized abscess rather than a spreading peritonitis results. Should the walling off process involve an adjacent viscus such as the urinary bladder or a loop of bowel, then an internal fistula may be established.

One of the most serious complications of ulcerative colitis is massive hemorrhage. As in active bleeding from a peptic ulcer, operative intervention is to be deferred if at all possible during the acute hemorrhage. The general condition of the patient is maintained in the meantime by transfusions of whole blood in the required amounts. In desperate cases which fail to respond to such expectant therapy,

an ileostomy may be attempted in the late stage.

Medications through the mucous fistula or by rectum are generally of any value in controlling the bleeding from the colon. Thrombin solutions, various hemostatics and astringents have been used without result, nor has the administration of vitamin K appeared to be of much benefit. Following ileostomy



Fig. 425—Double contrast barium enema showing pseudopolypoid. In this case the sigmoid and rectum were not involved. It was possible to perform an ileosigmoidostomy and to resect the involved bowel.

massive hemorrhage may occur from the colon. Such cases require careful supportive therapy. For surgical efforts to control the hemorrhage would demand colectomy. This procedure in the face of mas-

is a recurrent, marked by repeated tissue destruction and repair. As a result of the continued stimulation, regeneration and repair a pseudopolypoid lining frequently develops in the bowel (Fig. 425). In a small percentage

which cannot be ignored, however, malignant change sets in and carcinoma develops. It is likely to be a highly malignant form of carcinoma because of the young age group in which it occurs and be-

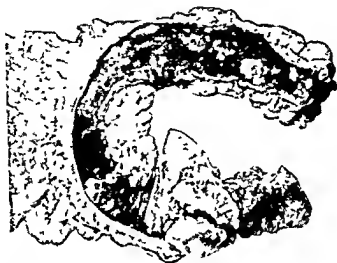


Fig. 426—Carcinoma of cecum superimposed on chronic ulcerative colitis of seven years duration

cause it manifests its presence by symptoms which are not unlike those of colitis and may therefore be attributed to the original disease (Fig. 426)

PREPARATION FOR OPERATION

The nutrition of these patients should presumably be at the best level which can be obtained by diet in the face of the disease. It is to be expected that this will be far from optimal for a nutritional disturbance is one of the very reasons why surgery is being undertaken. However, there is no excuse for permitting the patient to enter the operating room without making certain that his fluid balance is adequate and his blood chemistry within normal limits, especially the blood chlorides, carbon dioxide combining power, and urea nitrogen. The serum proteins may be quite low and can be only partially raised by oral or intravenous amino acids, plasma, serum and whole blood. The anemia, characteristic of this disease, should be corrected to a satisfactory level. Parenteral administration of vitamins may be advisable to overcome the avitaminosis commonly associated with long standing colitis.

Surgery in the fulminating case is to be avoided if possible. The mortality in such cases is extremely high. If such a case is seen early,

in ileostomy may be attempted in the hope that diverting the fecal stream may permit the body forces to control the source of the hemorrhage. The mortality of such surgery is of necessity high. In our experiences no local instillations or irrigations through the mucous fistula or by rectum are generally of any value in controlling the bleeding from the colon. Thrombin solutions, various hemostatics and astringents have been used without result, nor has the administration of vitamin K appeared to be of much benefit. Following ileostomy



Fig. 425—Double contrast barium enema showing pseudopolypsis. In this case the sigmoid and rectum were not involved. It was possible to perform an ileosigmoidostomy and to resect the involved bowel.

massive hemorrhage may occur from the colon. Such cases require careful supportive therapy for surgical efforts to control the hemorrhage would demand colectomy. This procedure in the face of massive hemorrhage would carry a prohibitive mortality.

In the natural history of ulcerative colitis there is a recurrent cycle of remission and relapse. Histologically this is marked by repeated tissue destruction and repair. As a result of the continued stimulation, regeneration and repair a pseudopolypoid lining frequently develops in the bowel (Fig. 425). In a small percentage

Crampy abdominal pain, sometimes associated with vomiting, may occur, even though the ileostomy may continue to drain. Before this technical point was appreciated it was necessary for us to revise the wound closure and release the constricting layer. The skin and the peritoneum are the most common tissues found to produce this constriction.

After closure of the wounds and the application of wound dressings, an in and out suture of heavy silk is placed in the open end of ileum which should project at least 2 inches above the surface of the abdomen. A mushroom catheter, the tip of which has been cut away, is introduced into the ileum and the suture drawn snug about the catheter. This provides a water tight closure for five to seven days, long enough to permit good healing of the wound. We do not thread the catheter through this ileum so that its tip passes beyond the abdominal wall within the abdomen. In one of our early cases death resulted from perforation of the ileum by the tip of the catheter when this technic was used. The clamp on the distal ileum (mucous fistula) should be left in place for five or six days.

We do not feel that loop ileostomy should be used in the treatment of this disease. It does not completely put the colon at rest and it affords an opportunity for the disease process to progress upward and involve the normal ileum of the proximal loop. The extra time required to carry out a divided ileostomy is not great and requires no added anesthesia. Even a poor risk patient can be carried through the operation successfully by the judicious use of intravenous fluids and blood.

POSTOPERATIVE CARE

The chief function of the large gut is that of resorption of fluid from the fecal stream. Following ileostomy, the body mechanism must readjust to the loss of this resorptive surface. In time the small gut takes over this function, but for several days the fluid and electrolyte loss may be so great through the ileostomy that several liters of a saline solution must be administered daily in order to maintain the fluid and electrolyte balance. The blood chlorides and carbon dioxide combining power must be watched closely and the urine output recorded so that the type and amount of fluid required can be accurately gauged. Even after fluid loss has been adjusted, electrolyte depletion, especially chloride loss, may continue and be unrecognized. This loss may not manifest itself for ten to fourteen days after operation. The patient, who probably has been doing quite well, suddenly develops lassitude, pallor, cyanosis, tachycardia, cold clammy extremities, a fall in blood pressure, crampy abdominal pain and perhaps nausea and vomiting. If a blood sample is drawn at this time the chloride level is quite low, and the patient responds dramatically to large amounts of intravenous saline.

however, and fails to respond promptly to medical treatment, i.e., in a matter of days, immediate ileostomy may save some in this group.

We have had no personal experience in the use of the indwelling Miller-Abbott tube in the ileum for a matter of several days as a "medical ileostomy."

ANESTHESIA

The anesthesia of choice in these cases is spinal. It provides excellent relaxation and a quiet field in which to work. This shortens the operative procedure and minimizes trauma. Even in poor risk patients a small dose of procaine intrathecally permits ileostomy to be carried out with ease and celerity.

OPERATION

The abdominal cavity is entered through a right lower quadrant muscle splitting incision. This incision is placed well inside the anterior superior spine of the crest of the ilium and a little higher than usual so that the bony prominence will not interfere with the subsequent fitting of a bag. The ileum is divided several inches above the level of the disease process, which usually stops sharply at the ileocecal valve but may extend well up the ileum also. The proximal loop is brought out through the incision as a permanent ileostomy. During the operation no attempt should be made to palpate the diseased bowel. Vigorous exploration may lead to rupture of this friable structure with a resulting peritonitis. The distal loop is exteriorized through a stab wound in the midline below the umbilicus. This will permit ready access to the remaining terminal ileum and colon without disturbing the permanent ileostomy should subsequent colectomy be necessary. Under no circumstances should the distal loop be turned in and dropped back into the abdominal cavity. Subsequent healing of the colon might lead to scar tissue contraction to such a degree that obstruction of the lumen would occur and a blind loop result. Several fatalities have been reported following rupture of such

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y colectomy to
prolapse. This can be minimized by tacking the mesentery of the bowel to the abdominal wall for a distance of several centimeters. No sutures should be placed through the gut itself lest fecal fistulas develop about the ileostomy and be a constant source of infection and annoyance.

Closure of the wound about the ileostomy should not be too snug. If the wound layers, especially the peritoneum, are too closely sutured around the ileum, there may result a partial obstruction of the intestinal lumen where the gut comes through the abdominal wall.

METALLIC SUTURES AND LIGATURES

W WAYNE BABCOCK, M D, F A C S, F I C S *

HISTORICAL ACCOUNT

THE use of metallic sutures and ligatures is not new, for the ancient Greeks used not only silk, hemp, catgut and tendon but also gold wire. Galen referred to ligatures of gold wire, as did Hieronymus fifteen centuries later when he lectured at Padua to William Harvey on ligatures and the valves of veins and laid a foundation for Harvey's *Anatomica de Motu Cordis*,² of 1628. Metallic ligatures apparently were then ignored until early in the nineteenth century, at a time when surgeons were greatly troubled by the chronic suppurating sinuses which followed the use of nonabsorbable ligatures and persisted until the ligature was removed.

It had become standard surgical practice to leave the long ends of the ligature hanging from the wound until it loosened and could be withdrawn. To avoid this delay in wound healing, Philip Syng Physick, Professor of Surgery at the University of Pennsylvania, had introduced absorbable ligatures of animal derivation but, not satisfied with the wound reactions that followed, in 1816 he suggested the use of lead wire sutures for he had noticed that leaden missiles embedded in the body often remained for many years without evident reaction. This stimulated H F Levert,⁵³ of Alabama, to perform a series of experiments in which the carotid or femoral artery of dogs was ligated with one of a variety of materials. In fourteen experiments ligatures of lead, gold, silver or platinum wire were used, none of which, despite the lack of aseptic technic, delayed healing or produced tissue separation, suppuration or other evidence of irritation or inflammation. Brass wire used in two experiments caused, however, a surrounding serous exudation and separation of tissues, while in all of the five experiments in which silk or gum elastic ligatures were used, an abscess formed about the ligature. On the basis of these observations, in 1832 Mettauer, of Virginia, first successfully closed a vesicovaginal fistula using sutures of lead wire.

J Marion Sims,^{52a} of Alabama, who had had a disheartening series of failures in his efforts to close vesicovaginal fistulas, including one attempt with lead wire, had a jeweler draw for him sutures of

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The ultimate life of these patients is made much more bearable by the use of a bag (Kernig Rutzen) which is fitted for each individual ileostomy and is cemented to the skin. The problem of skin irritation which was so disturbing because of the marked excoriation of skin about the ileostomy by the intestinal secretions is now avoided. The close fit of the bag opening about the ileostomy stoma keeps the patient dry and the skin normal. In lieu of the Kernig Rutzen bag, one of our patients places a condom about the ileostomy stoma. The end is cut off and placed within an ordinary colostomy bag. This functions so well that he has not used a Rutzen bag.

Many who have a simple ileostomy performed find complete relief from their symptoms and they require no further surgery. For those who have incomplete relief of their symptoms or recurrence at a later date e.g., discharge of blood, pus and mucus from the rectum, perirectal abscess or arthritis, resection of the colon in stages is indicated. If the condition of the patient justifies it, the terminal ileum, ascending colon, and cecum have been resected at one time. The stage of the disease at the time of operation is a factor in the decision. If this segment of the colon is the source of trouble it may

be preserved. Reanastomosis and sphincter control always remain as a remote though unlikely possibility.

We have had no personal experience with ileostomy performed in early mild cases of the disease carried out before irreversible and permanent damage to the colon has resulted. In some clinics the ileostomy has subsequently been closed with good results in 50 per cent or more of the cases. This no doubt is the goal toward which we should strive in the management of this disease for it is only by this method that we have any hope today of offering normal bowel function once again.

by changing classes of medical students in street clothing, with no measures for air sterilization or segregation. Of 4000 abdominal operations, seven of 2000 in which catgut was used in the wound closure had wound dehiscence, while of 2000 closed entirely with wire, only one patient, an emaciated aged man who had an intestinal resection for malignancy, had a wound separation, although the 2000 wound closures with wire included a higher percentage of gastrointestinal resections for malignancy than the other group.

To determine what reactions may occur from the use of various suture materials, I had three of my resident surgeons (G H Pratt,⁶⁹ Daniel J Preston⁷⁰, and O P Large⁵²) study phases of the subject as a research during their three year terms of service. Careful tests of wound healing indicated that the "six day lag" before progressive union occurs in a united aseptic wound is due largely to irritating sutures. With approximation by nonirritating sutures union began promptly and progressively increased in strength. Wherever catgut was placed as a suture or ligature in the abdominal cavity of a dog it soon was covered by adhesions. Over stainless steel wire and tubing, adhesions did not form. Three parallel incisions were made into a dog's stomach. One was closed with catgut, the second with silk and the third with stainless steel wire sutures. On reopening the dog's abdomen at the end of two weeks the catgut closure was found to be covered by a thick layer of adhesions, the silk by adhesions of a much lighter character and the wire by no adhesions. The most marked and destructive reaction from sutures shown by the experiments was that produced by catgut, either plain or chromicized. This was a very intense polymorphonuclear leukocytic infiltration, associated with some necrosis of contiguous tissues, the microscopic appearance being that of a beginning abscess. Similar clinical observations were made as we studied healing wounds in which sutures were buried or exposed upon the skin. Wound reactions from thyroidectomy, which had led to routine irrigation and drainage of the wound in many clinics, were not found when the less irritating fine silk sutures and ligatures were substituted for the catgut. The larger the size or bulk of catgut left in the wound the greater was the reaction.

Short sections of catgut introduced in sterilized skin and left with the ends protruding caused reactions corresponding to those observed in the microscopic sections of animal tissues. In two days the catgut was surrounded by an area of redness and swelling, with the formation of a dark lining zone and an area of relatively shallow ulceration. By the sixth day while stainless steel sutures left under a plaster cast for six weeks produced no clinical reaction. But most impressive to me were the results of operations by Glen Gibson³³ of the Department of Ophthalmology who sewed the clefts of a woman with a very

silver wire, and in 1849 performed his thirtieth operation to close the vesicovaginal fistula of the colored slave, Anarcha. A week later when he examined the patient he was struck by the excellent appearance of the wound. The fistula had closed, the surrounding tissues were not inflamed or swollen as after his previous operations, the sutures had caused no evident reaction on the vaginal surface, and the urine, instead of being foul and thick from the presence of mucopus, was clear and limpid. Two weeks later, by the same means, he had cured Lucy and Betsy of their fistulas, and in all is said to have successfully closed 200 vesicovaginal fistulas. Those who copied Sims in the use of nonirritating metallic sutures also had success. The wounds healed rapidly and with little inflammatory reactions.

Despite the success of Sims nearly one hundred years ago, and of those who followed him, vesicovaginal fistulas are now usually closed

by the patient by tying

the ureter for two weeks and oc

cluding the abdominal ap

proach, failures in closure are common. Were the fistula but accurately denuded and closed with fine, nonirritating wire sutures the patient would not need to be restrained, could be permitted out of bed the day after operation, would not require a suprapubic cystostomy, and failure of closure would be rare. At least this has been my experience. For best results one should not also introduce a tissue irritant such as catgut in the form of sutures or ligatures in such a wound. This is well illustrated by Tom Jones's results at the Cleveland Clinic.¹¹ Having had 28 per cent of infections in the abdominal wound after resection of the large bowel for carcinoma, he was persuaded to try a nonirritating metallic suture, but he also put in a layer of catgut. The percentage of infections then dropped to 18 per cent. Finally he tried an all stainless steel wire technic, when after 116 operations there was but one infection.

Personal and Group Experiences—About 1928 I obtained heavy "Allegheny" (18-8 alloy or stainless steel) wire which was used for wiring bone, and by 1931 the finer annealed alloy steel wire which I have since largely used for sutures or ligatures except for short periods of time when samples of tantalum wire obtained from two sources were under test. During the last seventeen years alloy steel wire has been used by members of the Surgical Staff of Temple University Hospital in over 20,000 operations, some with an all wire technic, others in which catgut, silk or other material was used as well as wire. Of 400 inguinal hernioplasties studied by George Rosemond there was one wound infection in 200 consecutive cases in which an all wire technic was used and six infections after 200 operations in

invisible protective film of tantalum oxide tends to form on the surface which is insoluble in most acids except concentrated sulfuric or phosphoric acid. When heated to 150 to 175° C or by the flame of a match in the presence of air, tantalum burns, with the formation of tantalum oxide. This renders it difficult and costly to isolate or process the metal. From the ore, tantalite, the metal is separated by an electrolytic process as a powder, which is consolidated by compression and heat in a vacuum. The metal is dense, ductile, and about twice the weight of iron. If in processing sufficient heat is generated, it must be protected from the air. It is therefore plated with copper which also acts as a lubricant, before being drawn into wire, the copper being removed by an acid bath.

Stainless Steel (18-8).—Stainless Steel is an alloy so strong and resistant to chemical and thermal change as to be called the "new noble metal." It consists of 18 to 20 per cent of chromium, 8 to 10 per cent of nickel, 60 to 70 per cent of iron, with small amounts of carbon, manganese, silicon and sulfur. Stainless steel has a melting range between 2550 and 2590° F, a specific gravity of 7.90, a cubic foot weighing 504 pounds, or about one half that of tantalum. It is a relatively poor conductor of heat and the soft annealed form used for surgical sutures and ligatures has a tensile strength of about 100,000 pounds to the square inch. In passivating a thin, transparent, protective film of chromium oxide forms upon the exposed surface. The 18-8 alloy steel resists corrosion by most chemicals except metallic chlorides, certain hypochlorides, bromine, chlorine, iodine, fluorides, chloroacetic, hydrobromic, hydrochloric, hydrofluoric and dilute but not strong sulfuric acid. By incorporating 2 to 4 per cent of molybdenum in stainless steel (18-8 MO) a greater resistance to chemical action is developed except to chromic, hydrofluoric, hydrochloric, hydrochromic or dilute sulfuric acid. This increased resistance is not essential in surgical practice. The soft annealed stainless steel wire used in surgery has a glistening chromium-like surface which is not tarnished after being buried in the living tissues for years, has a high tensile strength and is very flexible, so it may readily be tied in a close knot.

The surgical tantalum wire now on the market is slightly stiffer, and not quite so smooth as the alloy steel wire and therefore does not slide so readily into a knot as the alloy. It has about 50 to 80 per cent of the tensile strength of the stainless steel, is more brittle and is weaker where united by a knot, but is resistant to repeated flexions and extensions. Multifilament tantalum of 32 gauge broke at 483 flexions as compared with 390 for stranded stainless steel. The resistance of a wire to flexion and extension is of special importance when a continuous wire suture is to be buried in tissues, where it will be subjected to frequent bending. With the small wire loops left as buried interrupted sutures, tensile strength is more

fine stainless wire suture (41 gauge, or 0.0028 in.) The wire served both as the needle and the suture. A year later a second wire suture was introduced to close the coloboma more perfectly. The patient now has had these wire sutures in the iris for about six years without evidence of irritation.

COMPARISON OF THE METALS USED AS SUTURES

Wire to be used as a suture or ligature should be made of metal that is strong, very flexible and practically insoluble in living tissues, and therefore will not cause chemical or electrolytic reaction or staining. A brittle alloy like vitallium (compound of cobalt, chromium and molybdenum) cannot be drawn into wire, an alloy containing copper or zinc, which are particularly toxic *in vivo*, may be expected to cause tissue irritation. Titanium and monel metal lack essential physical or chemical qualities necessary in sutures and ligatures.

Silver is well tolerated when buried in living animal tissue, but with adjacent fluids forms chemical compounds, particularly a sulfide which stains the surrounding tissues a permanent dark green. The antiseptic quality of the compounds formed from silver in tissues and in culture media led to the extensive use of silver wire for the closure and of silver foil for the covering of wounds by Halsted. Silver wire not only permanently stains the tissues but lacks tensile strength and resistance to flexion and extension. Previous to World War I, for a number of patients I introduced ¹² a large silver wire filagree in the defective anterior abdominal wall, as suggested by the elder Bartlett.³ The silver wire was well tolerated, even in the presence of infection, but postoperative roentgenograms showed that the buried wire soon fragmented into many short pieces. Thinking that fine silver chain or silver mesh would be more flexible and less apt to break, I implanted the mesh or up to 15 feet of the chain between the layers of weakened abdominal walls.¹³ This also soon broke into many pieces yet gave considerable support as living tissue grew through the links of the chain. In later years a number of these abdominal walls have been reopened, revealing a widespread, intense dark green stain, the tissues, although living, appearing as if dead.

Of the elements, only tantalum has shown the ductility, strength and insolubility required for a metallic suture or ligature. Of the alloys, only the stainless steels seem at present to be adaptable.

Tantalum.—Tantalum, the 73rd element in the periodic table, has a

hot concentrated sulfuric or phosphoric acid, or by boiling unless they contain fluorine, free SO_2 or are strongly alkaline. A thin

from one spool to another, as each turn on the spool by hand may twist the wire 180 degrees. Then the wire comes off the spool in a series of coils. These when straightened out often form kinks in the wire that interfere with its being pulled through the tissues. Therefore the wire should be rolled off the spool without twisting, and cut in straight lengths usually about 18 inches long or coiled on special plastic cards. Each size of the straight lengths is made into a bundle of twenty five or more wires, which is given a spiral wrapping of No 35 wire, the ends of which are tied about the bundle. These bundles or cards of wire may then be sterilized repeatedly without harm in the autoclave or in boiling water with surgical instruments. It is advised that the wire be not sterilized while tightly wound on spools or on wooden bolders. The latter also may give off irritating resins or other products.

The wire also is supplied swaged in atraumatic needles, especially desirable for the suture of intestine, bile ducts, ureter, bladder, arteries, nerves, tendons and the like.

Selection of Wire.—Sizes of rustless wire employed for suturing will obviously vary with the structures to be sutured. To unite a nerve 0.015 inch in diameter, a 40 gauge (diameter 0.00314 inch) wire threaded in a No. 10 or 11 bead threading or atraumatic needle, or for closing the intestinal serosa, especially in an infant, size 39 or 40 permits a delicacy of technic hardly available with any other known suture material. For the intestinal serosa of an adult, 36 to 38 gauge (0.005 to 0.0039 inch) wire is employed, while 35 or 36 gauge (0.00561 to 0.005 inch) wire may be employed for the thick walled serosa of the stomach of an adult, 38 or 40 gauge wire is an excellent dermal suture as for the thin skin of an eyelid. For closing the abdominal wall of an adult 32 gauge (0.00795 inch) wire is employed for the peritoneum and overlying muscle, 30 gauge (0.01003 inch) for the aponeurosis of the external oblique muscle or the anterior sheath of the rectus muscle. Size 30 is the largest wire it is necessary to use in soft tissues. Subcutaneous fat is closed with interrupted 35 gauge, which also may include the skin. If a buried row of interrupted 35 gauge wire sutures has been employed in the fat, the skin of the abdominal wall is united with interrupted supporting sutures of 35 gauge wire, and a con-

several months. For most operations 35 gauge for closure of skin, fatty fascia and serosa, 32 gauge for suture of the thinner aponeurosis as in children and 30 gauge wire for adult, heavy fascial layers, muscle

Wires and Ligatures.—To prevent
on the sharp ends of the larger

sides of wire, the nurse should clamp the end of a strand of wire with

important than flexibility. Tantalum is, however, quite adequate for the closure of the abdominal wall or for other purposes of a metallic suture or ligature, and might be preferred were stainless steel wire unavailable.

When large quantities of wire are used by the surgeon the cost is to be considered. The present retail price of 30 B & S gauge tantalum wire is \$8.54 per hundred feet, for stainless steel wire, about 33 cents provided one-quarter pound (935 feet) is purchased. In wholesale quantities this size of the alloy is 10 cents per hundred feet. A tantalum plate of alloy steel of the same dimensions may be obtained for less than 25 cents.

Conclusion.—Living tissues are equally nonreactive to embedded tantalum and 18-8 alloy steel wire. Irrespective of the much greater cost of tantalum, the superior physical qualities of the alloy give it supremacy when used in operations.

EFFECT OF RADIATION OF METALS EMBEDDED IN LIVING TISSUES

It has been urged, apparently largely on theoretical grounds, that serious damage may result if solar, roentgen or diathermic radiation enters parts of living body containing embedded metal. Many of our patients having buried wire sutures in the abdominal wall or within the abdominal cavity have been exposed to roentgen rays without evidence of damage. At my request George Henney, of the Roentgen Department of Temple University, exposed animal tissue containing small plates of tantalum to heavy roentgenization and diathermy, but found no evidence of tissue injury. I therefore doubt if any one of

Prudence here suggests that diathermy should not be used and that direct exposure to the hot sun or to x rays be brief.

DIRECTIONS FOR THE SURGICAL USE OF STAINLESS WIRE

Before being submitted for surgical use the wire should be cleansed of lubricating material by the manufacturer by washing in carbon tetrachloride or other solvent and passivated or given a coating of chromium oxide and freed of microscopic metallic particles or other contaminants resulting from processing by immersion in 30 per cent nitric acid at 65° C for one half hour.

For the satisfactory use of stainless wire sutures and ligatures a special technic should be carefully followed. First the wire should not be twisted, as usually occurs when it is wound in the usual fashion.

from one spool to another, as each turn on the spool by hand may twist the wire 180 degrees. Then the wire comes off the spool in a series of coils. These when straightened out often form kinks in the wire that interfere with its being pulled through the tissues. Therefore the wire should be rolled off the spool without twisting, and cut in straight lengths usually about 18 inches long or coiled on special plastic cards. Each size of the straight lengths is made into a bundle of twenty five or more wires, which is given a spiral wrapping of No. 35 wire, the ends of which are tied about the bundle. These bundles or cards of wire may then be sterilized repeatedly without harm in the autoclave or in boiling water with surgical instruments. It is advised that the wire be not sterilized while tightly wound on spools or on wooden holders. The latter also may give off irritating resins or other products.

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Several months. For most operations 35 gauge for closure of skin, fatty fascia and serosa, 32 gauge for suture of the thinner aponeurosis as in children and 30 gauge wire for adult, heavy fascial layers, muscle sheaths and aponeuroses will suffice.

Method of Using Wire for Sutures and Ligatures.—To prevent injury to hands or rubber gloves from the sharp ends of the larger sizes of wire, the nurse should clamp the end of a strand of wire with

a hemostatic forceps and pull it from the bundle. The wire is first pulled between the gloved finger and thumb to determine if it has irregularities or weak spots, if present it should be discarded. The hemostat is used for tying knots in wire and for covering the sharp end until the strand has been used. For suturing, an inch of the wire is passed through the eye of the needle and folded against the portion of wire entering the needle as the needle is revolved by the opposite hand, forming a secure twist back of the needle. Firm traction is then made upon the hemostat and needle to flatten the loop in the eye of the needle and to make it properly trail the eye so that the loop will offer no resistance as the needle passes through the tissues. Multifila-ment wire does not form a secure twist and is therefore tied snugly to the needle eye by a half hitch and traction then made to flatten any irregularity.

The technic of tying the knot is important. Only a square knot should be used and the second half of the knot should be seated with firm traction. Under traction stainless steel wire may stretch from 50 to 60 per cent of its length and its surface then becomes somewhat rougher, and has a duller and less glistening appearance. By this microscopic roughening the knot becomes more secure. If the surgeon uses a surgeon's knot, or a knot with three hitches or ties the knot with one hand, a slip knot may form, one end of the wire simply making turns about the other, and the knot will pull apart. By test, the simple square knot has a tensile strength equal to that of the unknotted 18-8 wire. Leaving the ends long and twisting them together adds undesirable bulk to the suture, and is a disadvantage. The ends should be cut upon the knot so that no sharp point projects, best done by the curved plate-trimming or gum trimming scissors used by dentists. Surgical scissors as a rule do not contain the high carbon steel desirable for wire cutting.

Tying the suture or ligature without contact with the sharp ends of the wire may be accomplished in several ways. That used by the writer, after the suture has been introduced, is to pull the wire through by the needle in the grasp of the needle holder until only 2 to 4 inches project from the tissues to the hemostat. A midportion of the wire is then grasped in the palm of the left hand so that it passes from the needle end through the palm and over the terminal joint of the index finger (Fig 427, A). With the hemostat the short end of the wire is crossed over that on the index finger where it is held by pressure of the thumb (Fig 427, B). The short end is then released again to be grasped by the hemostat through the loop and then withdrawn with traction (Fig 427, C), completing the first half of the square knot (Fig 427, D). The left thumb is slipped under the long end of the
which is immediately covered by the short end held by the

stat is released (Fig 427 F) By depression and outward rotation of the thumb and index finger the short end of the wire is pushed through the loop again to be seized by the hemostat (Fig 427 G) when by firm traction the square knot is completed

Ligatures are similarly tied but with certain precautions A kink or other irregularity in the wire may prevent the tying of a secure knot so great care should be taken that the wire has no irregularity and that each half of the knot is securely seated With a ligature each half of the square knot is tied with strong tension With a suture the first half of the knot is tied lightly for mere apposition the second half with strong tension for security Stranded wire being more pliable

per m t a l e t t e s

st

st

double or figure of eight loop n

cases the hemostatic pressure

first half of each knot is seat

from which the wire may slip two ligatures should be used For an operation such as a thyroidectomy with an exceptional number of small arteries to be ligated I have felt that fine silk cotton or nylon forms more rapid and secure ligations

Continuous sutures of stainless steel wire may be employed very much as other materials are used For the skin a continuous suture saves time just as it does for the buried layers It has been suggested that the ends of buried continuous sutures be brought through the skin and that the sutures be withdrawn a week or so later I have tried this with buried 32 and 30 gauge wire but found that with a close spiral suture the wire could not be withdrawn All the wires under traction broke beneath the skin Lyons and Schulte⁵⁴ have used a continuous 26 gauge 18 8 wire for the deep layers and a 28 gauge wire as a continuous intracuticular suture These are given a rather open helical course through the tissues and withdrawn on the fourteenth day Such wire seems unduly coarse If great care is taken that the wire is free from all kinks and abrupt bends a finer wire as 35 or 32 gauge may be withdrawn after a week I have found no reason for placing wire of a larger size than 30 gauge in human soft tissues But the strength of a wound will be greater if the continuous sutures are left in place Thus far I have had no occasion to remove any of the buried continuous plain or multifilament wires A continuous monofilament tantalum wire which has less tensile strength I have not used The multifilament stainless wire is preferred for continuous suture as it withstands many bending movements (Table 1) Before using long continuous buried wire sutures the possible difficulty in removing such

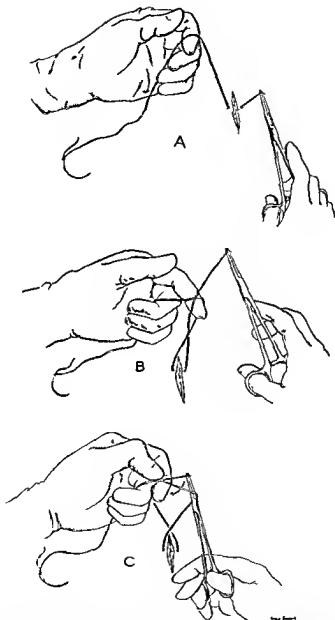


Fig 427—A, The wire suture having been introduced by a needle holder the midportion is grasped in the palm of the left hand so that it passes over the terminal joint of the index finger. B With the hemostat the wire is pulled through the tissue. C The wire is pulled through the tissue.

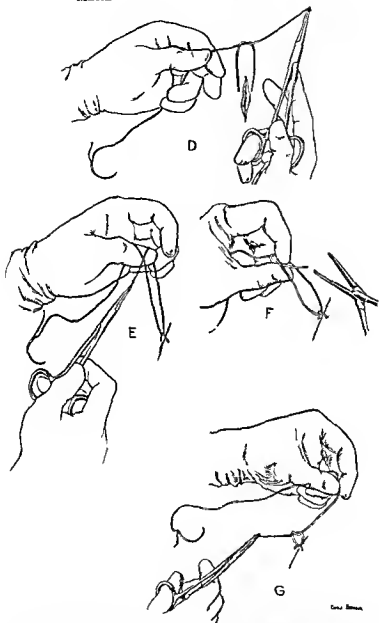


Fig 427 (Continued) -D, During the withdrawal the two hands revolve on a circle counterclockwise, completing the first half of the square knot. E, The left thumb is slipped under the long end of the wire, which is immediately covered by the short end held by the hemostat. F, The tip of the left index finger and thumb are now apposed as the crossed wires slip into their grasp when the hemostat is released. G, By depression and outward rotation of the thumb and index finger the short end of the wire is pushed through the loop, again to be seized by the hemostat, when by firm traction the square knot is completed

TABLE 1

APPROXIMATE COMPARISON OF SUTURE MATERIALS HAVING A DIAMETER OF ABOUT 0.008 INCH

	Monofilament 18 8 Stainless Steel 32 gauge	Multifilament 18 8 Stainless Steel 32 gauge	Monofilament Tantalum 32 gauge	Multifilament Tantalum 32 gauge	Silk 4/0	Cotton 4/0	Nylon 4/0	Catgut (USP)* 4/0
Tensile strength straight pull in pounds	07	61	27	42	2	25	29	2
Tensile strength on knot	0	51	23	28	18	18	21	1
Acute flexions before breaking	93	390	114	453				

* The strength of surgical catgut should exceed the April 1917 USP requirements. Samples tested showed, on straight pull, 3 pounds for the knotted and 3.4 pounds for nonknotted and on knot pull 18 pounds for knotted and 2 pounds for nonknotted catgut.

TABLE 2

APPROXIMATE DIAMETER OF SUTURES EXPRESSED IN INCHES, BROWN & SHARPE GAUGE, SPOOL COTTON AND USP STANDARD

Inches	0031	0039	0059	0079	0100	0113	0126	0142	0179
Brown & Sharpe Gauge									
Spool Cotton	40	38	36	35	30	29	28	27	25
USP	6/0	5/0	5/0	6/0	1/0		20	2/0	1

USP suture requirements permit variations of about 0.001 inch from those given for catgut with about 0.001 to 0.0015 inch greater diameter for nonknotted over knotted catgut.

all knotted ends in order to extract all of a continuous buried wire suture that spirals from one end of the scar to the other

MULTIFILAMENT WIRE

Stranded wire, in which a number of filaments are twisted together, as in a silk thread, may be made of annealed stainless wire, or the filaments may be *braided* to form a fine or coarse thread. Multifilament wire has a greatly increased resistance to repeated flexions and extensions, and is especially well adapted for a buried continuous suture in tissues subjected to repeated movement.

Seven strands of 18-8

0.0008

1.5

pounds

Stranded 18-8 wire thread 0.008 inch in diameter, 32 gauge, consisting of seven threads 0.003 inch in diameter twisted upon each other broke at 6 to 7 pounds straight pull. When two ends were united by a square knot, on traction it broke elsewhere than at the knot. Braided tantalum of corresponding size broke at 42 pounds straight pull and was weaker at the knot. Stranded stainless steel wire 0.013 inch in diameter, consisting of seven twisted filaments 0.0035 inch in diameter, broke at 18 pounds. Braided tantalum 0.0147 inch in diameter broke at 9 pounds. The tensile strength of a multifilament usually is about that of a single strand of the same diameter. Braided tantalum, therefore, from present samples, is less flexible and lacks the tensile strength of stranded stainless steel wire of the same diameter.

Stranded stainless steel wire
lengths unwound from a spool
tendency is even greater with

stranded or braided wire does not puncture gloves or fingers if made of the finer filaments. As previously stated it does not hold a twist as well as the single strand. To prevent it from pulling out of the eye of a needle therefore it should be secured by the first half of a square knot rather than twisting the wire together back of the needle.

It ties in a secure square or even "granny" knot and holds well when used as a ligature if properly seated. I have used it for interrupted and continuous sutures and for ligations in various operations, without reaction. With the exception of certain delicate procedures, as in peritonealization, the suture of blood vessels, nerves, tendons, ureters and thin walled bowel and plastic operations upon mucous membranes and skin it may be employed in place of the single strand of wire. The twisted stranded or the braided wire has a slight coglike quality when pulled through the tissues while strands of the more open twists tend to fray out at the ends unless knotted. Stranded

wire from its coil than the plain wire, although the monofilament is advised as a buried suture in contaminated fields.

Early postoperative ambulation. No other single factor has so greatly increased the safety of early rising after abdominal operations as the secure and nonirritating wound closure which may be obtained with stainless wire sutures. Not only may the patient often be per-

tendency to hypostatic congestion or having marked arteriosclerosis or diabetes usually are benefited by an early resumption of physical activity. After an *exploratory operation* revealing an inoperable carcinoma the patient is taken out of bed daily and encouraged to go home in three or four days and immediately resume such of his preoperative activities as he is able to perform. Such a patient usually requires less sedation and will be much happier than if he had been kept in bed until permanently bedfast. Apart from transient faintness I have seen no harm from permitting the patient to be out of bed during the early days after operation.

FATE OF BURIED STAINLESS STEEL WIRE

In the Temple University Hospital 18-8 wire sutures have been buried in hernias, used as a layer suture for the abdominal wall, as a fine dermal suture in plastic operations, to close a coloboma of the iris, and for sutures of the palate, larynx, trachea, esophagus, stomach, intestine, gall ducts, pancreas, pancreatic ducts, bladder, ureters, urethra, and tendons. The wire sutures have held well and the apposition of the tissues has been good. The closure of many fistulas (Fig. 428-429) and large hernias (Fig. 434) after operations with other suture material have failed.

In many secondary operations the wire sutures have been exposed and removed after being buried many months or years, and have been found without fibrous encapsulation or other tissue reaction or staining, and with the same bright, shining surface as when introduced. It has been rare to find a broken 18-8 wire suture although occasionally there was separation of the wire due to a "slip knot" tie. Wire knots with long projecting ends similar to those commonly left with catgut have caused discomfort and have been removed. Sharp wire ends overlooked upon the vagina have brought repercussions, and buried wire sutures left over a superficial bone, as the inner face of the tibia, have been annoying, indicating the need of a special education in the surgical use of wire.

If introduced with a proper technic, buried sutures of stainless wire are not painful, although it is to be recognized that the postoperative discomfort of an introspective patient may be attributed to anything including the sutures used. The possibility of legal action being taken



FIG 428

FIG 429

Fig 428—Cecal prolapse cecal and jejunal fistulas and herma following enterostomies for ileus from appendiceal abscess (Mr B) Condition after eighteen months of hospital treatment

Fig 429—Result of closure of fistulas reduction of prolapsed bowel and hernioplasty (Mr B) all wire technic three stages

based on alleged misuse of wire or of similar action for a disruption attributed to the failure to use wire in the abdominal wall may be contemplated

WIRE SCREEN OR CLOTH

Wire screen or cloth may be made of fine annealed tantalum or stainless steel wire so fine and flexible as to have nearly the pliability of a cloth yet with so many fine cross wires as to have surprising tensile strength. Such nonirritating metallic screen may be buried between layers over very weak areas of the abdominal wall for reinforcement and to prevent secondary stretching of tissues. The screen may be anchored in place by a number of fine wire sutures. During the healing process fibrous tissues will grow through the small openings in the screen giving added support and fixation. The cloth is made of wire from 0.0005 inch in thickness.

My resident surgeons, Karl Jonas and A. S. Casanova Diaz, experimenting on dogs found stainless steel screen and cloth to be nonirritating when placed in the tissues or on the peritoneum. Even when anchored over intact peritoneum tissue grew through the openings between the wires and in two weeks had covered the wire in a thin layer without adhesion to the adjacent abdominal organs. Even with 325 mesh wire cloth, made of wire 0.0005 inch in diameter with 325 strands to each inch of warp and each inch of woof, the openings

only 0.0025 inch in diameter were penetrated by new tissue. Stiffer wire screen may be embedded in the subcutaneous tissues to restore contours on the surface of the head, face or other parts. Wire screen given fixed desired curves buried in sliding or predicted flaps and perhaps lined by skin grafts may be used in difficult restorations as of the ear, nose, trachea and the like.

METALLIC CRANIOPLASTY

Plates of silver, platinum, gold, vitallium and alloy steel have been used repeatedly to cover defects in the skull. During the recent war tantalum was largely used, but stainless steel is lighter, equally non irritating, is easier to cut and shape at the operating table, and is in

results with stainless steel plates implanted in the skulls of dogs and have used the plates in five patients. They believe that plates of inexpensive stainless steel may replace with advantage those of tantalum for covering defects in the skull. In no aseptic case was there evidence of irritation from the metal. The plates used have been 0.015 inch thick. As serum may otherwise accumulate above or below any of the metal plates used, they should be perforated or a section of heavy stainless wire screen used as suggested by Boldrey.⁸ This screen is commercially available and inexpensive, yet so strong and rigid as to form an adequate replacement implant for large defects in the skull. Certain projecting wire ends of the screen may be bent down at right angles to be inserted in superficial drill holes made in the skull for fixation. The screen may readily be contoured over a form of proper shape and has an advantage over solid plates in that serum does not collect over its surface.⁹

METALLIC FOILS

Tantalum foil, which has been used about sutured nerves, is somewhat difficult to cut and wrap about the nerve and in the tissues may later become fragmented (18-8 foil should be better), but the wisdom of separating a sutured nerve from the surrounding blood supply may be questioned. In grafting defects in the facial nerve exposed in the mastoid the protection of a covering of gold foil as used by Ballance and Duell¹⁰ and Duell¹¹ seems of decided advantage from the results obtained.

USE OF WIRE IN ACCIDENT SERVICES, FIRST AID STATIONS AND INDUSTRIAL CLINICS

The accident service of a hospital usually has much of its work performed by interns and residents who may be guided by an experienced surgeon for certain hours during the day. It is a place where errors in

judgment and technic are not uncommon, with prolongation of healing and disability. It is important that only nonirritating sutures and ligatures be used. Some years ago we eliminated all sutures and ligatures except those of stainless steel wire from our accident dis-

technic was simplified and the expense of the department reduced.

A former pupil and present associate, John Minchert, has had seven and one-half years' service with industrial accidents, serving for two and one-half years in Pennsylvania state mining hospitals caring for injuries received in the coal mines, and for five years in the accident dispensaries of four Philadelphia hospitals, and with a large company manufacturing automobile bodies and stainless steel trams. In these services he has replaced the use of silk and catgut sutures by those of stainless steel. Lacerated and contused wounds were routinely closed immediately after the accident, with primary suture of divided tendons. No tendons have been lost and inflamed and suppurating wounds have been very rare, quite in contrast with the results previously observed from the use of silk and other suture materials. In his early practice a sulfonamide was dusted in the wound but this was followed by sluggish healing and the firm adhesion of tendons, so that during recent years no antibiotics have been introduced into the wound although they have been administered in other ways.

For the suture of nerves, tendons and muscles, stainless wire is the strongest and least irritating material at present available.

Three sizes of plain stainless steel wire 35, 32 and 30 gauge, will suffice for nearly all ligations and wound closures in an accident dispensary or industrial clinic, to which a few 38 gauge sutures with very fine needles may be added for the repair of a divided nerve or small tendon.

VARIOUS USES OF STAINLESS STEEL WIRE

Difficult Hernias.—Such hernias as well as those of the simpler type are best closed by 32 and 30 gauge stainless steel interrupted buried layer sutures. Properly introduced these individual sutures rarely break, untie or tear out. This applies also to tantalum wire.

Large Incisional Hernias.—Large hernias which result from separation of the abdominal wound rarely occur when the abdomen is closed with layers of buried 18 S sutures, and in the repair of such hernias the wire sutures are invaluable (Fig. 434). As a second stage procedure the sutures should be introduced in several layers using interrupted 30 and 32 gauge wire sutures. In the immediate closure of a dehiscence of an abdominal wound through and through 30 gauge sutures are useful. A part of them may be introduced well back of the wound edges as mattress sutures tied over dental cotton rolls to pro-

fect the skin. The tissues lining the wound usually are too degenerated to hold sutures.

Closure of Intestinal Fistulas upon the Abdominal Wall—Certain of these fistulas particularly those of the duodenum which may result from an accidental injury in freeing the renal pedicle in a right nephrectomy or the hepatic flexure in a right hemicolectomy, have been considered incurable. Nearly as difficult to close have been those of the sigmoid or descending colon resulting from an accidental injury

successfully closed with interrupted inverting fine wire sutures. For an intestinal fistula developing after an abdominal operation in a suppurating wound it has been considered necessary to delay repair of the fistula until the wound is free from active suppuration or necrotic tissue.

I have found that even in the acute purulent stage it may be possible to close such fistulas without extensive operation by merely in

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played in delicate operations upon the eye. In many cases it is not necessary to open the peritoneal cavity (Fig. 428). For a large traumatic fistula of the stomach which threatened the patient's life from loss of fluids and food elements closure was first made with inverting sutures of 35 gauge alloy steel wire but in twenty four hours the sutures broke under the strong peristaltic action. Sutures of 32 gauge wire were then introduced without anesthesia without secondary leakage and with recovery.

Suture of Mucous Membrane-Lined Cavities of the Abdomen—Stainless steel wire is particularly adapted for the closure of wounds in serous membranes as adhesions do not form over the sutures as over catgut and to some degree over silk. To peritonealize gastric or intestinal wounds after the inner and muscular layers have been united with fine catgut or silk, a size 36 or 38 wire is used, inserted with a small round cambric or a fine curved needle. The wire is especially desirable for the closure of fistulous tracts or to be used in the presence of septic contamination. Interrupted sutures are to be used so that peristaltic contractions and distentions of the alimentary tube are not interfered with.

Bile Ducts—A divided or incised common bile duct we have routinely united or closed during the past ten years with fine (36 to 38 gauge) wire used as an interrupted suture with the elimination of the irritating indwelling T or other tube of rubber. As there may be some secondary leakage of bile an aspirating sump drain is introduced to the vicinity of the suture line and continuous aspiration used for two or three days or until bile no longer leaks. This method has had a low mortality and has greatly reduced the postoperative confinement and morbidity.

Pancreas—After removal of a wedge shaped section of the pancreas as for pancreatic fistula the gap has been successfully closed with interrupted 35 or 36 gauge wire. To anastomose the pancreatic duct to the jejunum I have used a short section of rubber tube passed from within the pancreatic duct into the jejunum and temporarily anchored



Fig 430



Fig 431

Fig 430—Condition more than one year after eventration following Mikulicz resection of cancerous transverse colon in a 300 pound patient (Mrs D)

Fig 431—Result of single stage end to end transversostomy and reconstruction of abdominal wall (Mrs D) wire technic primary union

by a single fine catgut stitch so that the tube will later detach and be passed by the intestine. The surrounding cut surface of pancreas is then closely attached to the adjacent intestine by surrounding interrupted layer sutures of 35 or 36 gauge wire.

After partial gastroesophagectomy or total or partial gastrectomy for cancer, I have used interrupted seroseros sutures of wire for the outer coat.

The One Stage Pull Through Operation for Rectosigmoid Carcinoma—Preservation of functional sphincteric and perineal muscles which I first started to develop about 1929 owes much of its success to the use of nonirritating wire sutures and ligatures. The operation is best performed without the use of any other suture material. The abdominal part is like a rather expanded first part of the Miles operation except that the bowel is liberated with wider margins of perito-

neum and no pelvic peritoneal diaphragm is formed. Experience has shown that a peritoneal diaphragm is quite unnecessary and that it limits the radical nature of the operation. In several cases in which we have operated to transplant to the perineum an objectionable abdominal colostomy after a Miles operation, an unsuspected recurrence of the carcinoma has been found in the pelvic diaphragm. One should have no hesitancy in denuding the pelvis of cancer-bearing peritoneum as this rarely causes troublesome adhesions. The recto-sigmoid having been liberated through an oblique lower left abdominal incision and the wound closed with wire sutures, the asepticized rectum is divided just above the divided sphincters and with the sigmoid pulled through the divided sphincters and pelvic floor. The levator ani muscles are closed in layers without tension with size 32 wire and the skin with 35 and 38 gauge wire, no sutures entering the bowel. The



FIG 432

FIG 433

Fig 432 Baby E aged 1 year Exstrophy of bladder

Fig 433—Baby E aged 18 months All wire closure of exstrophy. Partial urinary control.

only drainage used is a sump drain to the pelvis through the abdominal incision. The primary union which usually occurs in both

Bladder—Stainless wire is the best suture material for the closure

of a cancerous infiltration. In other cases however I have seen calcareous deposits on the wire. In a number of patients we have anastomosed the ureter end to end with wire or have implanted the end of the ureter into the bladder. For the latter the end of the ureter has been split for about 1 cm and each half attached to a length of

catgut with a needle on each end. The needles are passed through an opening in the bladder and the split ends of the ureter spread apart on the vesical lining by bringing each pair of needles through the bladder wall from within and tying the ends on the outer surface of the bladder. Finally the bladder is inverted where the ureter enters it by interrupted sutures of size 36 wire.

Exstrophy of the bladder in an infant or young child (Fig. 432), particularly is a challenge to the finesse of one's surgical ability and an acid test of fine suture materials. To reconstruct the small bladder the minute urethra and external genitalia invites a superlative handicraft and the use of instruments and needles perhaps more delicate than those yet available. Only stainless wire fulfills the suture requirements. It is desirable to close the bladder in the early weeks of life to protect the mucosa from mechanical irritation and infection. The reconstruction of the urethra and external genitals may be performed later. Unfortunately with growth the pubic bones tend to separate farther stretching the urethra and impairing continence. I have obtained a partial control for considerable periods of time with alloy wire closure (Fig. 433).

Cleft Lip and Palate—In the closure of these defects we have for years used only stainless steel wire. It has given results far superior to those obtained by catgut, silk or silver wire previously used. With the wire successful closures have been obtained repeatedly after previous operative failures. Interrupted and at times mattress suture have been used, the size of the wire varying from 35 and 36 to 40 B & S gauge, depending on the age of the patient and tenuity of the tissues. For the uvula and soft palate, an upper and lower row of size 38 wire introduced with a very fine curved needle is preferred. For the anterior part of the palate and lip the larger and stronger sizes may be required. Some of the fine wire sutures have remained in the palate for many years with little irritation. For all plastic operations within the mouth the nonirritating noncapillary quality of the wire associated with pliability and strength give it priority.

Vesicovaginal Fistula—Such fistulas are closed with the greatest incidence of success with fine stainless wire (36 or 35 gauge). At least one layer of the wire should be buried. As the superficial layer of wire may be difficult to remove from the vaginal side after the operation even in the Sims or knee chest position there is a temptation to use very fine (00 to 000) catgut to close the vaginal surface, but best results may be obtained with an all wire closure. A Sims sigmoid silver catheter is useful during the early postoperative stage. In none of our cases although a number had had previous unsuccessful operations through the bladder or abdomen was a cystostomy necessary.

Rectovaginal Fistulas—For the lower or midrectovaginal fistulas it usually is best first to split the perineum and rectovaginal partition to the fistula for free drainage and especially to allow the fecal

neum and no pelvic peritoneal diaphragm is formed. Experience has shown that a peritoneal diaphragm is quite unnecessary and that it limits the radical nature of the operation. In several cases in which we have operated to transplant to the perineum an objectionable abdominal colostomy after a Miles operation, an unsuspected recurrence of the carcinoma has been found in the pelvic diaphragm. One should have no hesitancy in denuding the pelvis of cancer-bearing peritoneum, as this rarely causes troublesome adhesions. The recto-sigmoid having been liberated through an oblique lower left abdominal incision and the wound closed with wire sutures, the asepticized rectum is divided just above the divided sphincters and with the sigmoid pulled through the divided sphincters and pelvic floor. The levator ani muscles are closed in layers, without tension, with size 32 wire, and the skin with 35 and 39 gauge wire, no sutures entering the bowel. The

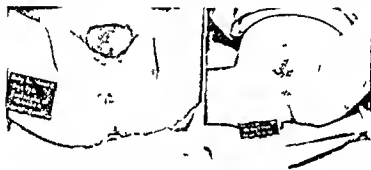


FIG 432

FIG 433

Fig 432—Baby E, aged 1 year. Extrophy of bladder.

Fig 433—Baby E, aged 18 months. All wire closure of extrophy. Partial urinary control.

only drainage used is a sump drain to the pelvis through the abdominal incision. The primary union which usually occurs in both the abdominal and perineal wound I attribute largely to the exclusive use of wire sutures. In 320 operations of this type personally performed there has been no wound dehiscence.

Bladder—Stainless wire is the best suture material for the closure of the bladder but it should not be exposed on the mucous surface as infection may follow. In one patient there were no exposed wire that had been exposed to the bladder after the excision of a cancerous infiltration. In other cases, however, I have found calcareous deposits on the wire. In a number of patients we have anastomosed the ureter end to end with wire or have implanted the end of the ureter into the bladder. For the latter the end of the ureter has been split for about 1 cm. and each half attached to a length of

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vaginitis to subside before attempting the closure, which then is accomplished with layer interrupted sutures of fine 36 or 38 gauge wire. A sigmoidostomy is of great advantage as a preliminary to the more difficult closures. In one patient who had a history of eighteen previous operations the fistula was eliminated by transplanting the abdominal colostomy through the sphincter ani, a second with a history of eleven unsuccessful operations for tuberculous rectovaginal fistula after a course of tuberculin had a successful closure of the fistula and her colostomy. In both an all wire technic was used.



FIG 434

FIG 435

Fig 434—Hernia following gallbladder operation with catgut, and wound dehiscence (Mr F aged 52)

Fig 435—After all wire closure of hernia Fig 434

Perineorrhaphy.—For a secure restoration of the pelvic floor catgut is not dependable, as in many cases the muscles will pull apart and retract if chromic catgut is used. I believe Frederick M Douglass first had the temerity to unite the levators ani with stainless steel sutures. The muscles should be well exposed and for marked rectocele two layers of interrupted 32 wire sutures introduced in the muscle, taking care that they are not directly against the vaginal wall. The vagina may be so tightly closed as to correct an extreme procidentia and the procedure serve as a substitute for the Le Fort operation.

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METHODS AND ADVANCES IN SKIN GRAFTING

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SKIN grafting, like other types of tissue grafting has developed in the nineteenth century. Tissue grafting in general received an impetus after the discovery of the tremendous regenerative forces going out from the host area. The question as to what starts regeneration—the wound itself or the loss of tissue—must be answered. The wound attracts hyperemia and unleashes all the innate forces of the tissue for restoration. This is the start of growth. Depending upon location and size of the defect, the healing of the wound will result in restitution ad integrum, or in a scar. The latter is considered an inferior replacement of a defect. Transplantation of tissue is performed to produce a more similar replacement of the lost tissue and to avoid scar formation, or to replace a scar.

Although skin grafting was a well developed art at the beginning of the century, its real development began after the first World War and resulted mainly from vast experience and improvement in technic. Gillies, Lexer, Davis, Blair, Brown and Padgett were foremost in developing new techniques and increasing immensely the percentage of good results. To J. B. Brown we are indebted for the perfection of the technic of skin grafting to such a degree that it has become the method of choice in many instances where a flap formerly was considered indicated.

Choice of the Graft.—The two most widely used grafts are the large split graft, consisting of partial thickness of the skin, and the large full thickness graft. The split graft, as originally used by Ollier and Thiersch, was cut thin and consisted only of the epidermal layer of the skin with a small portion of dermis, but these grafts are too thin for use on surfaces where firm covering is required. Hence, the graft should be cut thicker and should consist of from one half to three quarters of the thickness of the skin. The full thickness graft consists

of an area, no matter how harmless the infection on granulating surfaces only the split graft needs to be considered. On the other hand, if the host area is "clean," a choice must be made between the split and the full thickness graft.

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Hypertrophic Granulations—Hypertrophic granulations are exuberant, boggy, edematous, and overhang the wound edges. To reduce their size and to change them into flat granulations, several measures may be tried (1) Silver nitrate may be applied daily with a caustic stick or in solution, followed by application of gauze soaked in Dakin's solution, then a layer of cotton (or cotton mechanics waste) and a firm pressure dressing (2) Another method consists of trimming the exuberant granulations with scissors, followed by the application of silver nitrate and a pressure dressing (3) Daily baths and exposure to ultraviolet rays may be of value

Infected Granulations—These granulations are gray and covered with fibrin, and discharge a purulent exudate. Under such conditions, a daily saline bath is essential. For patients with large infected areas a daily tub bath in comfortably warm water with 5 per cent salt may be life saving. The surrounding skin should be cleansed with soap and water. Daily debridement of dead tissue is necessary. The area is covered with dressings soaked in Dakin's or other antiseptic solution which is added at regular intervals. In profuse discharge the dressings should be changed twice daily. Cultures should be taken from the infected area. Depending upon the type of germ found sulfonamides, penicillin or both are administered. If necrotizing processes are present, sprinkling of the area with crystal sugar (which need not be sterile) may be given a trial. The sugar owing to its hygroscopic properties, causes a profuse exudation and hence an elimination of fibrinous membranes and necrotic tissue. If the granulations tend to bleed, application of zinc peroxide is recommended (Altemeier and Carter). If the discharge becomes less, the wet dressings are alternated with ointment, such as cod liver oil, scarlet red or mercury ointment, or with balsam or Peru. Heliotherapy may be of value. Twenty four hours before the operation isotonic saline dressings are applied which are moistened at regular intervals.

Sluggish Granulations—If the wound stimuli is lacking, this may be done

If the ulcerative area is surrounded by dense cicatricial tissue, the entire surface, including the granulating area ought to be excised down to the firm fibrous tissue base, and this base should be covered immediately with a skin graft.

Immediate Preparation of Recipient Area—The operation starts with the preparation of the recipient, or host, area which is changed into a clean wound. In case of a granulating area the granulations are not touched if they are flat. If the granulations are hypertrophic, they are sliced downward—not scraped—with a sharp, long knife to a yellow

In general it may be stated that on all surfaces where the cosmetic effect is not important and on surfaces that will resist subsequent contraction, split grafts should be used. The split graft is more easily obtained and applied, takes more readily, and the after care is less difficult. But a drawback lies in the fact that it changes its color, owing to pigmentation, and does not resist subsequent contraction.

The full thickness graft changes its color also, but not so much as the thinner graft. Furthermore, the full thickness graft prevents recontraction to a certain degree. Hence, in regions in which the cosmetic effect is of importance or which are exposed to pressure, and in which optimum relaxation is required, the full thickness graft should be employed.

Condition of the Patient.—The patient's general condition has much bearing upon the outcome of a skin grafting operation. Anemia and hypoproteinemia delay wound healing. Any disturbance of the fluid balance may affect normal metabolism. No patient should be subjected to skin grafting unless the hemoglobin level is well above 60 per cent and the serum protein level above 6.5 gm per 100 cc. Transfusions of blood and plasma are the chief remedies for correction of secondary anemia and hypoproteinemia. In some cases, as severe burns with large denuded areas, the hemoglobin and protein levels may remain low in spite of countermeasures. In these circumstances life itself may depend upon covering the raw surfaces, hence, one may be forced to proceed with skin grafting, and even resort to homogenous grafts which however become absorbed in a few weeks, but may improve the patient's general condition. Fluid intake and output should be well balanced. A high caloric diet is important. Vitamin deficiency must be watched for. Vitamin C is essential to wound healing and its deficiency leaves the connective tissue cells in a state of immaturity. Other vitamins, such as A, B and D, are also essential to wound healing. Hence, a high vitamin diet, supplemented by ascorbic acid, iron and heliotherapy, stimulates general and local health.

Preoperative Preparation of the Donor Area.—The donor area is shaved (with the exception of areas from which grafts are taken to be transplanted to a woman's face or to line cavities), preoperatively, it is washed with soap and water, ether and alcohol, and covered with a sterile sheet.

Preoperative Preparation of the Host Area.—The host area is prepared in a similar way, unless the surface is granulating. If the host area is granulating, the chances of "take" of a skin graft depend

worked out (Tidrick and Warner, Young and Eavata), but this in my experience does not provide as firm adhesion as does Sano's method. With all these methods adhesions, once they have formed, must not be broken up if good results are to be obtained. An application of a dressing would certainly break them up, hence they are open to criticism. I have recently modified the fibrin fixation method by using thrombol, a suspension of all blood clotting principles extracted from fresh brain tissue of the calf. To prevent moving of the graft after application of the thrombol the following procedure is employed. The graft is sutured in place, and just before application of the pressure dressing a sufficient amount of thrombol is injected between graft and host area, and the pressure dressing is applied immediately.

Dressing of Grafted and Donor Areas.—The graft must be kept in close contact with the graft bed. This is done by a pressure dressing. The graft is covered with a layer of xeroform gauze, then follows a dressing which will transmit an even pressure, which may consist of a thick layer of sterile cotton or mechanic's white cotton waste. The entire dressing is placed under firm pressure with gauze bandages followed by elastic bandages. If one is dealing with an extremity, it is then immobilized and elevated.

The donor area is dressed with xeroform gauze. I highly recommend rayon also, which has been introduced by Neal Owens. It has a sufficiently close weave to block ingrowth of capillaries into the fabric, permits adequate drainage, has a low coefficient of friction, and permits easy sterilization. The donor area from which a full thickness graft has been removed is either closed by skin sliding or by a split graft.

After-treatment.—On clean wounds the dressing may remain in place for from eight to ten days. On granulating wounds the dressing should not remain longer than five days. After removal of sutures and any slough another dressing is applied consisting of moist (saline) gauze until the graft has healed. The grafted surface is then protected with ointment dressing and should be massaged daily with cocoa butter or cold cream.

Changes of color of skin grafts transplanted to the face may be counteracted by tattooing. The recent work of Byars, Brown and associates using this method appears most promising.

low, well vascularized layer, which constitutes the base of the granulations

Removal of the Graft—The split graft is removed either by free hand with a long sharp knife or with a dermatome. The full thickness graft is always removed by free hand. The split graft consists of a one half to three fourths thickness of the skin while the full thickness graft consists of the entire thickness of the skin. In removing full thickness grafts care should be taken that no fat tissue is allowed to remain on the graft. In removing a split graft with a dermatome the use of backing material has been found helpful to prevent the graft from folding and stretching. Webster uses phlofilm. Green, Levenson and Lund use nylon backing for dermatome grafts. I have found the nylon cloth very satisfactory. The drum of the dermatome is coated with cement. A fine gauge nylon cloth is cut the size of the drum and cemented to it as smoothly as possible. A new coat of cement is now applied to the nylon and to the donor site and the graft is cut. The graft with its backing is removed from the drum with hemostats and placed on the host area. Since the backing prevents the graft from shrinking it may not be necessary to hold the graft in place with sutures. The nylon backing should be removed at the time of the change of the first dressing when it can easily be peeled off. The nylon cloth can be sterilized as easily as any other textile.

Transfer of the Graft—The graft should be trimmed so that it fits perfectly into the defect. If the skin overlaps most of the overlapped tissue would become necrotic and slough. Parts of the overlap would regenerate thus causing an irregular hypertrophic scar. The graft is fastened to the wound edges with continuous or interrupted silk sutures and also to the base of the graft bed with basting sutures. A few stab holes are cut in the graft with a pointed knife to allow

has been devised by Sano. I have used her method on various occasions with gratifying results. The method consists of preparing two solutions which when brought together develop a fibrinous adhesive coagulum simulating in intensified forms the normal adhesive process occurring in wounds. The graft adheres within a few minutes. A single strip of boric acid gauze is placed over the graft. No other dressing is applied. The application of a dressing may break up the fibrinous adhesions thus defeating the purpose. The chief disadvantage of the method is that since no pressure dressing is applied the grafted area must be carefully protected from mechanical interference. This in certain regions of the body is almost impossible to accomplish. The time consumed in preparing the solutions is another disadvantage.

To obviate such delay a fibrin fixation method has been recently

HOMOGRAFTS

In spite of what one reads in the newspapers from time to time homografts—from one person to another—are not permanent even though they “take” at the outset. They invariably disappear in from three to ten weeks by some process which is not yet determined. Rare instances are recorded in which skin has been permanently transferred from one identical twin to another. However homografts may be life saving in a patient with large raw areas who cannot be conditioned for a long operation of using his own skin. Thus a great loss of serum constantly escaping from the raw surfaces may be prevented and with blood transfusions, proper vitamin therapy and the ingestion of

effect on the permanent take of homografts but there has been no evidence to substantiate this theory.

PREPARATION OF WOUNDS FOR SKIN GRAFTING

It is of course of the utmost importance that the general condition of the patient be maintained at a high level. A high protein hemoglobin and red cell level must be attained and maintained by transfusions and one of several high protein concentrated foods if grafting is to be successful. Infection must be reduced and kept at a minimum. This is often a troublesome problem in some burned areas such as those near the rectum where it is very difficult to rid the area of the colon bacillus. We wish to obtain firm red granulations as a base for the reception of the grafts. If the granulations are exuberant they can be somewhat reduced by the application of tincture of mercuric iodine and firm wet dressings to reduce the edema. These dressings may be of normal saline, chlorhexidine liquid, dilute potassium permanganate and the like and should be thoroughly moist but not sloppy and too macerating.

Grease dressings are preferable on fine mesh gauze and may be of plain petrolatum with all excess scraped off—or better still of 5 per cent scarlet red chlorhexidine or furacin water soluble ointments. The latter two are so called “greaseless ointments” and should be changed daily. They may need a little soaking before their removal because of their tendency to dry out. If ointment dressings of any kind are used wet dressings must be substituted for at least three days prior to the skin grafting.*

The time to graft then is determined by the general condition of the patient and of the granulating wounds.

* The pharmaceutical house that puts out furacin claims that when this product is used—and I have recently found it to be excellent—one need not change to wet dressings before grafting because it is a water soluble ointment and therefore the grafts can be placed on granulations that have been treated with it. I have not used this method.

THE SKIN GRAFTING OF BURNS

LAWRENCE CURTIS, DDS, MD, FACS*

The literature on the skin grafting of burns is very extensive, particularly since the beginning and termination of the last war. Those who have talked and written on this subject agree in the fundamental principle of early skin grafting of burned areas involving at least the full thickness of the skin—of covering as great an area of raw granulating surface with as much skin as possible as soon as possible.

We shall not discuss the treatment of burns but rather briefly consider the early skin grafting of burned areas which may often be begun in as short a time as three to four weeks following the accident—the preparation of the wounds for skin grafting, the application of various types of grafts, the after care and some of the reasons for the failure of the grafts to “take.”

Before discussing these matters something should be said about the spontaneous healing of burned areas. Years ago this was a method of choice with the loss of many lives because of the lengthy exposure of raw surfaces and the eventual development of deforming scar contractures in those who were fortunate in surviving. Even today many burned areas involving the full thickness of the skin are allowed to heal spontaneously with resulting deformities following no serious attempts at skin grafting. There are sometimes valid reasons for so doing where the surgeon has no choice—donor areas at a premium, infected granulating areas that will not clear up, the continuing poor general condition of the patient and the like—but these are in the great minority. Brown and McDowell have shown that the scar epithelium

turn out to be en-
contains no glands
nourishment and

care and the maintenance of high blood and protein levels some patients will heal over a large full thickness loss with an epithelium that may be permanently satisfactory. Others may heal quickly but with dense scar deformities while still others may grow no epithelium worthy of the name. Therefore whenever possible—and it usually is—skin should be grafted in large quantities at an early date.

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variable intervals, especially on the back and abdomen where the skin is thick

The use of full thickness grafts and pedicle flaps is so limited in the early plastic treatment of burned areas that we will not prolong this paper with a discussion of their application. They have an important place in the later phases of treatment of scar formation resulting especially in contractures. And frequently burned areas, such as the sole of the foot, which have been covered with split grafts, have to be replaced by full thickness grafts or pedicle flaps for proper weight bearing.

THE APPLICATION OF SPLIT GRAFTS

I have already pointed out the requirements of a suitable bed for receiving split grafts. To briefly review—firm red granulations as free from infection as possible are desired. If the granulations are thick and edematous they should be shaved off—not scraped—with an old skin grafting knife down to a firm base. This will cause considerable bleeding which the patient cannot very well afford and should be done quickly and followed at once by wet dressings of hot saline held by an assistant under pressure. These will control the bleeding and insure a suitable dry bed for the reception of the grafts.

Split grafts can be cut in two ways—free hand and with a dermatome. Several types of knives are used in cutting the grafts free hand—those of Ferris Smith, Brown, Blair, Caltagurone and still others—but all of them are long and they must be sharp. The prepared donor area is covered with a thin film of petrolatum, some flat surface such as a wooden tongue blade flattens out the skin both in front of the knife and behind it and the strokes are made with the knife from the shoulder. Blair and Brown have devised a suction apparatus to draw up the skin about 1 inch in front of the cutting blade. The technique of using these knives and of using the dermatome have been described many times and at some length and there is no need to go into too much detail here. It must be frankly stated that, while in very experienced hands large split grafts can be cut free hand, most of us rely at present on the dermatome to cut relatively large grafts to cover large raw areas. Unfortunately, a good many operators do not get all they can out of a dermatome because they miss a few fundamentals in its use. The donor area is to be scrubbed with soft soap and water, dried and then daubed with ether to make it thoroughly dry. It is then painted with *thin fresh* rubber cement which is allowed to dry five minutes by the clock. At the same time as the donor area is being covered with the cement the ether dried drum of the dermatome is also covered with some of the same fresh, thin cement, being sure to cover the anterior border of the drum, and likewise allowed to dry for five minutes by the clock. If this time is not allowed for drying of the cement the skin will not adhere to the drum in the process of cut

The presence of the *pyocyaneus bacillus* in wounds of large extent with the tell tale greenish color and musty odor on the dressings often plagues us no end. When this is the case it is usually associated with the use of ointment dressings and can be cleared up in variable periods of time with wet dressings. Many solutions have been advocated to rid the wound of this infection such as gentian violet, acriflavine and other dyes, dilute acetic acid and 1:2000 potassium permanganate, but it has been our experience that the application of normal saline dressings with a sprinkling of finely divided sulfadiazine powder for a few days will clear up the condition.

A bacterial count of the area to be grafted should be made. One should not expect to get sterile cultures excepting in very small areas. It has been suggested that a combination of penicillin and streptomycin—which apparently act symbiotically—in a strength of 20,000 units of each per cubic centimeter of saline be used locally when both gram positive and gram negative organisms are present in quantities sufficient to make them offensive. We have not used this combination.

TYPES OF SKIN GRAFTS

Pinch grafts or *small deep grafts* were originally described by Reverdin and are still used by some surgeons because they are probably the easiest to take from the donor area and usually do well on granulating surfaces, but they have little, if any, place in modern skin grafting. Portions of the skin involving the deeper layers are picked up by the point of a needle to form a cone shaped elevation and then cut at the base with a knife giving an area of practically the full thickness of the skin about 1 cm. in diameter. They will cause more final scarring than any other type of graft because of the healing between the small grafts by scar epithelium. They also leave unsightly donor areas. Many good donor areas have been ruined for taking sheet split grafts by this method.

Split or *intermediate thickness grafts* are the best type to use in covering large burned areas. They are the grafts of choice in covering small areas too, and small pieces—*stamp grafts*—can be cut from a large sheet of skin to cover these defects. Ollier and Thiersch were among the first to use a split graft of skin, describing the taking of many small thin sections with a razor. Such very thin grafts have a definite place in skin grafting of certain regions but not in the covering of raw burned areas for they are little better than spontaneous scar epithelium. The term "split graft" is advocated by such excellent operators as Brown and McDowell and implies the use of sheets of skin cut manually or with a dermatome at least 20/1000th of an inch in thickness—which will include the essential dermal pad. This pad is apparently lacking in spontaneously healing scar epithelium and contains such important elements as sweat glands and elastic tissue for support. Several crops can be cut from the same donor areas at

and smoothing it out toward the opposite side. Too much must not be used for fear of washing away valuable tissue juices.

The *pressure dressing* on the graft is one of the most important steps in the entire operation. Brown and McDowell say its application may well require half an hour in some cases. We have not timed the pro-

whether grease or wet dressings are to be used. *Grease* dressings are preferable if the wound has been properly prepared and may be of 5 per cent scarlet red—our preference—5 per cent xeroform, a thin layer of petrolatum or the like, covered with several layers of ordinary gauze. Mechanics waste finely torn into fine shreds is then applied copiously and firm pressure made with an ace or ordinary roller bandage. This is fixed with ample strips of adhesive plaster. Where there is likely to be any movement in the grafted area between the graft and its bed, as in the neck or around the shoulder or over the ribs, the waste should be fixed over the graft in the form of a stent by stout sutures placed in the skin just outside the boundaries of the graft and tied over the waste. Plaster splints should be used when joints are involved. If *wet* dressings are to be used—and some surgeons prefer them routinely—the same procedure is followed without of course the initial layer of the grease.

The *donor area* is dressed with fine mesh strips of 5 per cent scarlet red ointment, several layers of ordinary gauze which are fixed with adhesive tape and an over all bulky dressing wrapped with a roller bandage if possible and adhesive. This dressing should not be touched for fourteen days unless it should become very soupy about the edges and even then it is often better to leave it alone and merely clean up what has oozed. After the dressing is removed it is often entirely healed and the area is then covered with baby oil or cold cream and left without dressings. If there are any spots where the graft has been cut too deep these should have been closed with sutures at the time of the operation. At the time of removal of the dressing any sutures thus applied will have to be removed.

A *split graft dressing* should not normally be disturbed until the fifth day if some kind of ointment has been used or on the third day if wet dressings have been used. All sutures are removed at this time excepting in small children where fine catgut sutures have fixed the grafts and any loose overlapping pieces of skin are cut away. If the graft is dry and pinkish in color the same type of dressing as the original one is used again and subsequently changed at three or four day intervals until the graft is firm and has completely "taken" after which dressings may be left off and the newly grafted skin covered with baby oil. If there are any moist or soupy areas in the grafts when the dressing is first changed, wet dressings should be substi-

ting the graft I have seen many failures in taking grafts with a dermatome because the operator has been in too much of a hurry to get the drum on the skin and begin cutting. Many a sharp cutting blade has been unjustly blamed for such failures. And one more caution when using a dermatome. After the graft has been cut to the end of the drum it is left temporarily attached to the skin, then the graft is peeled off the drum, being grasped at the free border and the ends by small hemostats, and constantly covered with blood from the cut surface by the finger on the cement side to prevent the surface of the graft from rolling and sticking together. After the graft has been treated in this way and relaxed where it came from the distal end is cut free from its attachment to the skin and the graft is at once applied to the recipient area.

Apropos of the direct application of the graft from the donor area to the recipient area it is interesting to note that about a year ago two general surgeons reported on the treatment of burns in one of the leading journals and had a new method to offer in the grafting of skin. The "accepted technique of placing the grafts in saline solution and later transferring them to the recipient site was abandoned" and, instead, they adopted the method of immediate transfer of the skin from the donor to the recipient area. I have never delayed any graft in saline solution—in fact, I thought that method went out with the horse cars. And, too, these men believe "skin grafting in the treatment of burns is not the problem of a plastic surgeon." Possibly not.

The edges of the graft should overlap the normal skin edges and those of each other about 1 cm., if possible, when multiple strips are used. If there is not enough skin to cover the raw areas the edges may have to be spaced and the resulting narrow granulating strips cover over spontaneously.

The sutures used are usually No. 000 braided silk on $\frac{3}{4}$ inch half curved cutting edge needles. We like to use No. 0000 plain catgut in small children as these do not need to be removed and apparently

normal tension of the skin. During suturing of multiple strips a few sutures can be placed in the inner portions of the graft to fix it firmly to its new bed and thus prevent the formation of clots which are the arch enemy of successful "takes." Some prefer drainage slits at intervals in the graft to allow the escape of any oozing blood and thus clot formation but they are apt to leave scars and do not always accomplish their purpose. During the course of the fixation of the graft it should be smoothed out at intervals to force toward the periphery any oozing blood or clots which may have formed. It is sometimes advisable to wash out any such collections of blood under the fixed graft by injecting a small amount of normal saline under one edge

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tuted for a few days. If there are open raw spaces between the grafts they are covered with furacin fine mesh gauze and changed daily.

When large raw granulating surfaces are but partially covered with grafts we have found it very satisfactory to dress the grafts as indicated and the adjacent raw surface with furacin fine mesh gauze both under pressure. The dressings of both grafted and raw areas should then be changed in three days and repeated as many times as necessary. After the graft has reached the no-dressing stage the raw area is dressed with furacin or a wet dressing as indicated previously in the preparation of the wound for grafting.

CAUSES OF FAILURE IN SKIN GRAFTING

There are several causes for the failure of grafts of skin to "take" in the early care of raw burned areas with granulations. Infection is the chief cause. The bacillus pyocyaneus of which we have previously written is the chief offender. Hemolytic streptococci and skin staphylococci are other common offenders and in wounds near the excretory orifices the *Bacillus coli*. Movement of the graft on its bed because of improper pressure dressing of the graft or inadequate immobilization of the part which has been grafted and the oozing of blood beneath it with clot formation will prevent a successful "take". And finally grafts will not do well if the general condition of the patient is not good. There is such a thing as having patients confined too long within the four walls of a hospital room and in such instances they simply do not do well no matter how intelligently they are cared for. Giving them a change of environment will usually better their whole well being mentally and physically so that they can later be returned to the hospital for further treatment.

SUMMARY

An attempt has been made to point out some of the fundamentals in the skin grafting of burns which have proved their worth in our experience and which may be overlooked or forgotten for the moment during the course of intensive treatment.

Nothing has been written about the fixation of grafts by thrombin.
Young and Favata
have had practically

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is encountered and suture of the corresponding tendon ends is carried out with one of the usual tendon sutures. Then follows transection of the nerve ends until uninjured nerve bundles are encountered and suture of the divided nerve. The divided ligaments and fascia are closed over these structures followed by closure of the skin with a few interrupted sutures (Fig 437).

In the palm locating the proximal tendon stumps is usually more difficult than at the wrist. The proximal stumps are apt to contract considerably and may be found above the wrist. They are located from separate small transverse incisions over the wrist. Before locating the tendons however the median nerve should be exposed and safeguarded. Only then the tendon segments are pulled out of the proximal wound and the very tip grasped with a mosquito forceps. A temporary guide suture is passed through the tip and tied. The ends of the suture are left long. To pull the proximal stumps peripherally into the original wound the opening of the proximal tendon canal in the original wound is located. A probe with eye first is inserted through the opening and passed in a retrograde manner through the canal until it appears in the proximal wound. I found the retrograde insertion more helpful than passing the probe from proximal to distal. The temporary silk sutures are threaded into the eye of the probe and the probe is withdrawn pulling the proximal tendon stump into the original wound (compare with Fig 441 B). Then follows suture of the divided nerves and tendons.

If *sublimus* and *profundus* tendons are divided Koch and Mason doubt the wisdom of having two layers of suture at the same level in close approximation. To prevent adherence to one another they advise laying the *lumbricale* muscle between the two tendons at the line of suture and holding it in place by one or two fine sutures. Then follows closure of the wound.

On the volar side of the finger primary repair should be attempted only under the most favorable circumstances. The slightest infection or irritation following repair will cause scar formation within the sheath and adherence of the tendon sheath so that not only the immediate result will be spoiled but also secondary repair becomes more difficult. Isehn, Koch, Mason, Myer, Cutler and others go so far as to advise against primary suture even under the most favorable circumstances. Bunnell went even further by recommending a secondary repair and substitution of the entire divided tendon by a graft to avoid a suture line within the sheath. Mason and Koch however with an improved technic, recently demonstrated good functional results in a few cases when the operation was performed within a few hours after the injury. They advise excision of the fibrous tendon sheath over the area of repair thus the line of suture comes to lie directly against fatty subcutaneous tissue with less likelihood of adhesions.

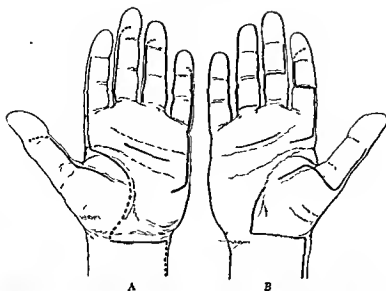


Fig 436—A, Correct incision in the hand. At the hand the lateral incisions are the best. At the palm the incision should be parallel with the crease. In the wrist they should be transverse. Dotted lines indicate additional extensions and combinations. B, Bayonet incisions in the hand (Mason).

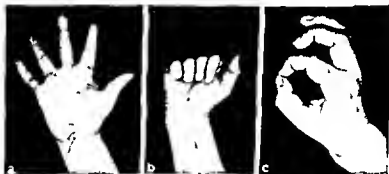


Fig 437—A, Dorsal view of the hand.

B, Palmar view of the hand.

C, Hand in fist position.

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started. Return to light work. Physical therapy was continued 5 days a week for two months. Patient was then discharged *b* and *c*, Good function of the hand.

Although the tendon division may occur at any point along the volar surface of the finger, the most common site is in the level of the web. At this level there are three tendons within the sheath—the two slips of the sublimis tendon and the long flexor tendon passing between the slips. If the sublimis and profundus tendons are divided, it is generally agreed that only the profundus tendon should be united. If the sublimis tendon is sutured also, a considerable mass of sutures is brought together in a small space causing adhesions and preventing the profundus tendon from its action on the terminal phalanx.

In repairing severed dorsal tendons the same rules are applicable as for the volar tendons (Fig. 438).

SECONDARY REPAIR

Secondary repair of severed tendons and nerves becomes necessary if, because of the above named conditions of the wound or the passing of the time limit, primary repair was omitted. It is also employed in

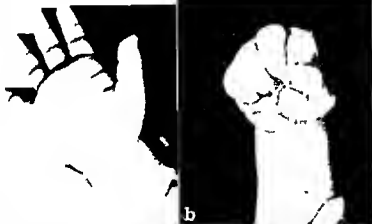


Fig. 439—*a*, Child aged $2\frac{1}{2}$ years, fell on glass and severed all flexor tendons in palm with the exception of the profundus. Late repair elsewhere. After examination it was found that the profundus and the median nerve were not functioning. A secondary operation was performed. The palm was opened from the former incision. The profundus was repaired. The fine distal stumps of the median nerve were gathered and sutured en masse to the main trunk in the palm. Immobilization on a dorsal molded plaster cast splint with the thumb in abduction and opposition. The splint was removed after three weeks. The only physical therapy the child had was a daily handbath. *b*, Full functional return.



those cases in which primary repair has failed. The problems involved in secondary repair are by far more difficult to deal with than those in primary repair owing to adhesions and retraction of the severed tendons. It must be reiterated too that difficulties mount tremendously after unsuccessful primary repair. Quite often retraction is of such degree as to make an approximation of the corresponding tendon ends impossible and the surgeon must resort to tendon grafting in order to bridge the gap. One should not forget that stiff joints which cannot be moved passively are a strict contraindication to any tendon repair unless mobilization is possible either by physiotherapy or operatively.

The divided and the destroyed tendons and nerves are located from an incision similar to those depicted in Figure 436 A and B. The surrounding scar tissue must be entirely excised until only healthy tissue is left. All tendon and nerve tissue which is devitalized, cicatricial or frayed is excised with a sharp knife until normal looking tendon tissue is encountered, no matter how large the resulting defect. The tendons and nerves are then sutured together as described under Primary Repair. In the presence of dense cicatricial tissue around the tendon and nerve sutures, thin layers of fat grafts are removed from the deep fat layer lying directly along the fascia lata of the thigh and are transposed between the sutured structures. If union of the tendon segments is impossible because of rigid contraction of the muscles or because tendons have sloughed away or become cicatricial necessitating excision, we must resort to tendon grafting to bridge the intervening gap. In a previous article I have described the details of tendon grafting. Figure 441 illustrates the various technical steps.

AFTER TREATMENT

After treatment is as important as the operation itself. The healing process of a tendon wound passes through two stages: the proliferative and the formative. The first stage is characterized by the formation of a callus which is composed of fibrous tissue and cartilage. The second stage is characterized by the replacement of the callus by matured connective tissue. The latter author, who did considerable experimental work on this subject, came to the conclusion that functional use during the first phase did not accelerate the development of the tendon callus. On the contrary, functional activity appeared to be harmful in so far as it caused more reaction of the surrounding tissue and weakening of the union. Later, however, after

spending nerve stumps were sutured together. The arm was immobilized on a

L4 U 5U

b-d Patients hand had regained almost full function nine months after the second operation.



those cases in which primary repair has failed. The problems involved in secondary repair are by far more difficult to deal with than those in primary repair, owing to adhesions and retraction of the severed tendons. It must be reiterated, too, that difficulties mount tremendously after unsuccessful primary repair. Quite often retraction is of such degree as to make an approximation of the corresponding tendon ends impossible, and the surgeon must resort to tendon grafting in order to bridge the gap. One should not forget that stiff joints, which cannot be moved passively, are a strict contraindication to any tendon repair, unless mobilization is possible either by physiotherapy or operatively.

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AFTER TREATMENT

After treatment is as important as the operation itself. The healing process of a tendon wound passes through two stages, the proliferative and the formative. The first stage lasts about two weeks, during which the tendon stumps become united by a connective tissue callus. The latter is then gradually converted into tendon. Mason and Allen, who did considerable experimental work on this subject, came to the conclusion that functional use during the first phase did not accelerate the development of the tendon callus. On the contrary, functional activity appeared to be harmful in so far as it caused more reaction of the surrounding tissue and weakening of the union. Later, however, after

second operation.

FIGURE 441

b-d Patient's hand had regained almost full function nine months after the second operation.

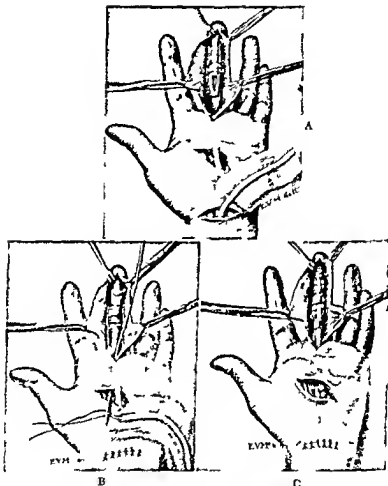


Fig 441—A Secondary tendon repair of the flexor tendons of the third finger

1. A tendon graft is passed through a transverse incision at the base of the middle phalanx.

of the probe

C The tendon graft has been passed through the palm through the annular ligament over the middle phalanx, and has been fastened to the terminal phalanx.

the first callus has formed, restricted use of the tendon caused but slight irritation with rapid increase in tensile strength of the union

It is common belief among surgeons that motion if started early will prevent the adhesion of tendons. However, according to the already mentioned findings and clinical experience, the opposite seems to be the case. Early motion, restricted or unrestricted, favors adhesions. The latter are not only due to irritation of the surrounding tissue, but also to disturbance of the vascularization of the tendon—a fact which should be strongly emphasized. The bulk of the blood supply of a tendon out

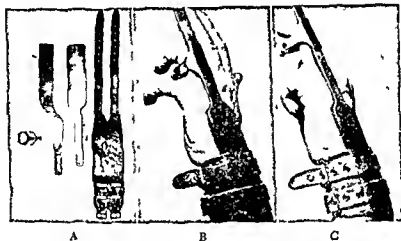


Fig 442—A, A finger splint which permits independent active exercises of the interphalangeal joints of the fingers

B, The splint in use. The flexor profundus tendon of the fourth finger was replaced by a tendon graft. When active exercises were instituted without the splint, the patient moved mainly the joint which was movable before the operation, namely, the metacarpophalangeal joint. To force the other joints to active exercises, the splint is applied, a clamp is slipped over the finger and splint holding the metacarpophalangeal joint immobilized. The patient now moves the first interphalangeal joint.

C, Clamp immobilizing middle phalanx. Patient can now exercise the terminal joint.

side its sheath is derived from the paratenon. It is only natural that a tendon operation causes some disturbance of the local circulation, since it is almost impossible to leave the intimate connection of the paratenal tissue undisturbed. This is particularly true in tendon grafting. If, however, the involved tendon is adequately immobilized, the interrupted blood supply of the paratenon and tendon will become reestablished

A new annular ligament has been reconstructed at the first phalanx by using one of the slips of the sublimis tendon. The tendon graft has not been united as yet with the proximal tendon stump of the flexor profundus tendon.

hand is placed in such a position that the suture line is under a minimum of tension. After two and one half weeks, splint and dressing are taken off temporarily and the sutures removed. Forearm and hand are placed daily in a warm saline bath and active motion exercises are encouraged. The splint is reapplied after the bath. Three weeks after the operation, the splint is discarded and local heat (baking, warm water bath), massage, and passive exercises are added to the active exercises. In addition to physiotherapy, occupational therapy may be necessary.

One of my patients developed a simple but very effective splint for exercising those joints which move freely (Fig. 442). Since the introduction of this splint, some of my patients have gained full motility of the fingers without physiotherapy. Whenever tendons and nerves are repaired, the hand must be immobilized so that the paralyzed muscles are in position of relaxation to overcome the functional antagonists. The splint should remain applied until first signs of recovery of the nerve function, namely, return of sensory function, become evident. The splint, however, is removed temporarily for daily institution of physiotherapy. Galvanic exercises of the paralyzed muscles are added to the exercises described above. In the periods between exercises the patient is urged to move all joints which are not necessarily immobilized.

SUMMARY

Reparative surgery of severed tendons and nerves of the hand and after treatment are discussed. One point has been stressed in particular. Primary repair should be performed if the wound is clean and made by sharp instruments; if the emergency dressing is carried out aseptically, and if the patient is seen within the first six hours after the accident. Whenever one is in doubt concerning the possibility of primary repair, it is infinitely better to do only a primary wound repair of the skin, and leave the tendon and nerve repair until the wound of the skin has healed. The functional results are better after primary repair, but the prognosis is poorer if primary repair has failed and secondary repair is required.

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COMPOUND FRACTURES AND THEIR MANAGEMENT 1917-1947

CALVIN M. SMYTH, JR. M.D., F.A.C.S.* AND T. A. RANIERI,
M.D., M.Sc.†

WITH the cessation of hostilities and the lapse of sufficient time during which older and recent experience might be reviewed, the presentation of another paper on compound fractures and their management seems justified. Trends in surgical thought and procedure should follow along lines of sound judgment based upon both knowledge and experience. There is a growing tendency to discard old tried and proved procedures in favor of new ones without applying the yard stick of time or comparison. Many mistakes were made in World War I and yet some of those same mistakes were repeated in World War II. Many were carried away by their enthusiasm first for the sulfonamides and later penicillin, and were ready to throw overboard the sound principles of good surgery in the complacent belief that they were no longer necessary.

For example, some reporters stated in the early period of the recent war that it was not necessary to debride or otherwise mechanically disinfect contaminated traumatic wounds since spraying with sulfathiazole or sprinkling with sulfanilamide crystals was all that was required. This recalls sharply to mind an incident during a period of instruction to a group of newly commissioned medical officers in 1917. The chlorine antiseptics were enjoying the brief period in which they were curing everything and the instructor state (and believed it) that it was no longer necessary to incise an abscess widely since a simple puncture followed by the introduction of an oily solution of dichloramine T with a medicine dropper would suffice.

Certain principles in the treatment of war wounds were laid down by the Army Surgeon General in 1917 and have stood the test of time. The Spanish Civil War, which began in 1936 and ended in 1939, following his bacteriologic experiments, advocated what he termed "refreshing the wound." From Botallo's "De Curandis Vulneribus Sclopetorum" and Pare's "Methode de traiter les playes" to 1947 is a far cry and while certainly no one advocates a return to the surgery of

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those times, one cannot but comment, and with regret, on certain deprecatory communications and directives from responsible military quarters during the recent war regarding the treatment of compound fractures

A compound or open fracture is one in which there is a direct communication between the site of the involved bone and the outside air. This type of fracture constitutes one of the most serious of all emergencies. Most of these fractures are contaminated at the time of infliction, therefore no distinction is made between fractures "compounded from within" or those "compounded from without." However, secondary infection must be prevented by avoiding additional contamination from attending personnel and frequent dressings. Although there is no uniformity of opinion regarding compound fractures, the fundamentals of surgical treatment remain the same. These are outlined in Table 1.

TABLE 1

FUNDAMENTALS OF SURGICAL TREATMENT

A First Aid Treatment

- 1 Splinting and transportation
- 2 The treatment of hemorrhage
- 3 The control of shock
- 4 The prevention of infection
- 5 Preparation for operation
- 6 Choice of anesthesia

B Definitive Treatment

- 1 Physical cleansing
- 2 Treatment of the wound
- 3 Treatment of the bone
- 4 Reduction and fixation of the fracture
- 5 Joint injuries
- 6 Care of the wound and immobilization
- 7 Indications for amputation

FIRST AID TREATMENT

1 The dictum of "*splint them where they lie*" applies to compound fractures. Although no attempt should be made to reduce the fracture, traction should be applied prior to transportation of the patient to the hospital or to the x ray room from the receiving ward. The wound should be inspected.

2 *Hemorrhage* as a rule is not a major factor and most bleeding can be controlled by pressure dressings. Usually the tourniquet is unnecessary and should be employed only when the main vessels of the limb have been injured.

3 *Shock* is a common accompanying condition and requires immediate treatment. The treatment of shock in the first aid view consists in splinting the fracture, covering the wound, keeping the

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DEFINITIVE TREATMENT

All compound fractures are emergencies. Naturally one would prefer to operate within the first six hours and not later than the tenth hour from the time of the infliction of the injury. If the patient is operated upon within this period the following procedures are employed

1 The wound is protected with sterile gauze and careful physical cleansing of a wide area of skin around the periphery of the wound is done. White soap and water is used followed by benzine, ether, alcohol and an antiseptic solution (tincture of zephiran or merthiolate)

2 *Treatment of the Wound*—Before describing the treatment in detail certain terms should be defined. We have found considerable confusion to exist in the minds of experienced surgeons and graduate students. *Débridement* literally means unbridling the wound or relieving constriction of the wound by incision, i.e. opening up the wound and cutting the systematic procedure of opening the meticulous removal of all devitalized tissue from the periphery to the uttermost depth of the wound. The skin edge is grasped with a toothed forceps and a thin strip of skin and subcutaneous tissue trimmed with a sharp scalpel all around the wound. All foreign bodies and loose fragments of bone are removed, the constricting fascial bands are severed and the intermuscular planes are laid open and cleared. No pockets should be left in the wound which might give rise to infection later. Devitalized tissue usually does not bleed when incised and healthy muscle contracts when pinched. When *débridement* is carried out properly the wound should look clean and no blind spaces or recesses should be present. This procedure gives the soft tissues every chance for healthy regeneration. *Epluchage* is peeling or picking of the inner surface of the wound to examine the tissues minutely. *Parage* or paring of the wound is the extirpation of the wound. The English equivalent of *épluchage* and *parage* would be *excision*, i.e. the entire wound is excised "en bloc". The incision is made wide of the wound in normal tissue, the skin margins are excised and the incision is carried down to and around the base of the wound. By this procedure all of the foreign material such as hair, dirt, clothing or loose bone fragments, as well as devitalized or potentially devitalized tissue is removed.

(a) The entire wound is carefully excised "en bloc" as described above. However, only the experienced surgeon with knowledge of anatomy of that particular region should employ this method so as not to excise any deep vital structures. We do not advocate the con-

giving morphine
patient is able
to miss an

is given if necessary. This treatment should begin at once and should be continued while transportation, roentgenography, or preparation for operation are going forward. The patient should be kept warm and comfortable but should not be overheated. The practice of delaying operation upon shocked patients until recovery from the so-called primary shock, so common at one time, is no longer considered good surgery. As stated previously, the treatment of shock should begin at the earliest possible moment, but it should accompany other measures. The earlier definitive treatment of the injury is instituted the more rapid is the recovery from shock.

4 *The prevention of infection* as a first aid measure should be focused on the prevention of secondary infection. If active bleeding is present a firm sterile dry gauze dressing is applied, otherwise, a sterile gauze compress saturated with alcohol is applied to the wound. The time factor in the prevention of infection in these injuries is very important. The injured limb must not only be properly dressed and splinted but the patient must be brought to the hospital as quickly as possible. Finally, every patient with a compound fracture should receive a prophylactic dose of the combined tetanus gas gangrene antisera. This dose is repeated in five days. If the individual is a veteran or has had tetanus toxoid immunization a booster dose should be given. We do not employ local implantations of sulfonamides or penicillin as there has been no appreciable difference, in our experience, in the results in those cases in which these drugs were used and those treated without them. If there is to be any appreciable delay in definitive treatment, 200,000 units of penicillin is given intravenously with the infusion of 50,000 units intramuscularly and continued at regular intervals.

5 *Preparation for Operation*. A preliminary x-ray should be taken only if the patient has had the aforementioned attention and immediate definitive treatment is contemplated. Roentgenographs at this time are a help and a guide in subsequent treatment of the injury, particularly in demonstrating extension of the fracture and the presence of radiopaque foreign bodies.

6 *Choice of Anesthesia*. Although local anesthesia has been recommended as a factor in preventing and reducing shock, we feel that it is inadequate in dealing with extensive compound fractures of the extremities. Brachial block anesthesia may be used for the upper extremity. Intravenous sodium pentothal is the anesthetic of choice for short procedures and spinal anesthesia for longer procedures in the

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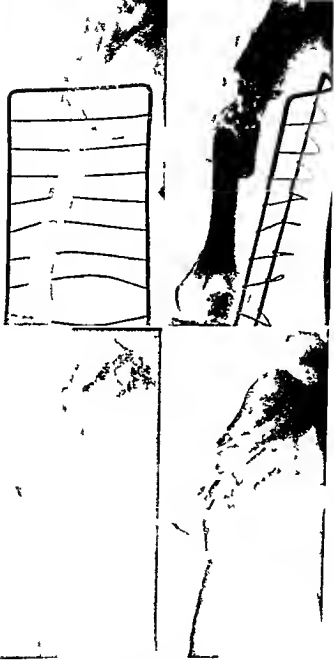


Fig 443 (See legend on facing page)



Fig 443 (Including facing page) Compound comminuted "multifragmented" fractures of the upper third of the humerus fractures were produced by different sized bullets shrapnel and fragments of shells Wounds of entrance of gunshot wounds accompanying these fractures were usually small and dimpled whereas the wounds of exit were large with extensive damage to the underlying structures



Fig 444—Roentgenogram taken on May 10 1945 "Hanging cast" type of plaster encasement with an extended plaster shoulder cap This cast was applied on April 7 1945 following definitive treatment as described in the text Removed on May 11 1945 at the symposium on the first redressing in the demonstration of the Orr method to military and naval authorities Revision of casts in the fourth and fifth weeks were those of the casualties incurred in the first ten days in the Battle of Okinawa and treated in Military Government Hospital G-6 No 51

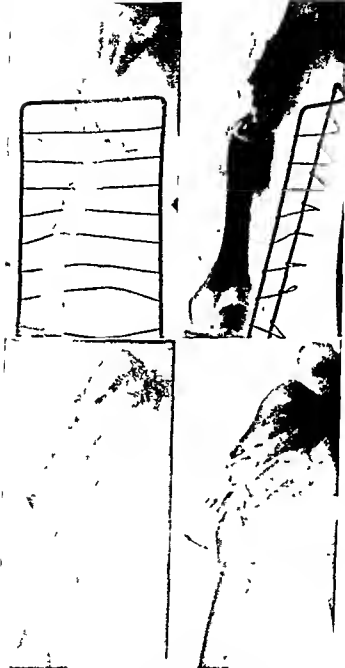


Fig 443 (See legend on facing page)

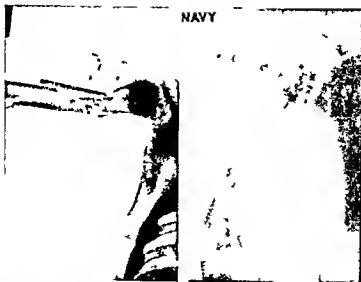


Fig 443 (Including face and neck) - Fractures of the upper sized bullets shrapnel wounds accompanying the wounds of exit were large with extensive damage to the underlying structures



Fig 444 - Roentgenogram taken on May 10 1945 "Hanging cast" type of plaster encasement with an extended plaster shoulder cap. This cast was applied on April 7 1945 following debridement. The cast was applied on May 11 1945 at the of the Orr method to m. lit and fifth weeks were those Battle of Okinawa and tr



Fig. 6. Larva of *Phaenocarpa* sp. (top left) and *Phaenocarpa* sp. (top right) showing the position of the head and thorax. (bottom left) and (bottom right) showing the position of the head and thorax.



FIG. 446—Compound comminuted multi-fragmented fracture of the lower forearm. Below Appearance of upper third of the ulna following Orr treatment and plaster encasement.

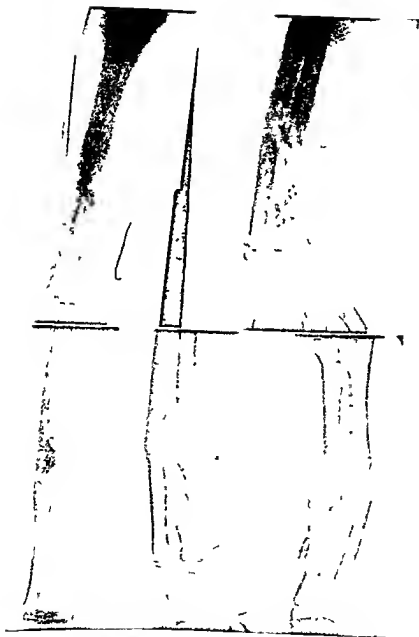


Fig 417—Compound, comminuted fractures of the forearm with loss of bone substance of the radius bone. Fractures were treated by the Orr method and subsequently bone grafts were applied to the radius.



Fig 448—Above, Compound, comminuted, "multifragmented" fractures of the femur with considerable amount of debris, shrapnel and shell fragments present in the wound and soft tissues. Below, A similar fracture showing anteroposterior and lateral views.

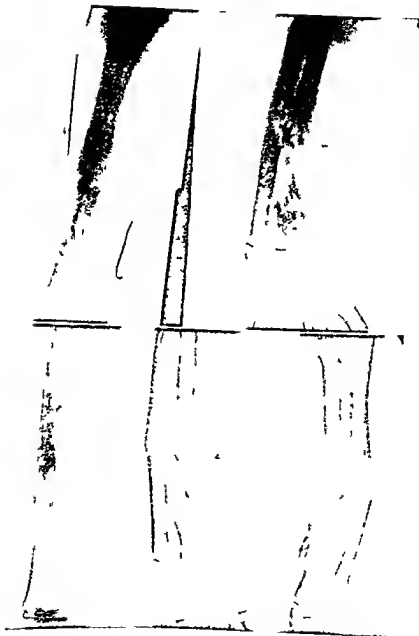


Fig 447—Compound, comminuted fractures of the forearm with loss of bone substance of the radius bone. Fractures were treated by the Orr method and subsequently bone grafts were applied to the rad.



Fig 418—Above Compound comminuted multi-fragmented fractures of the femur with considerable amount of debris shrapnel and shell fragments present in the wound and soft tissues. Below A similar fracture showing anteroposterior and lateral views.

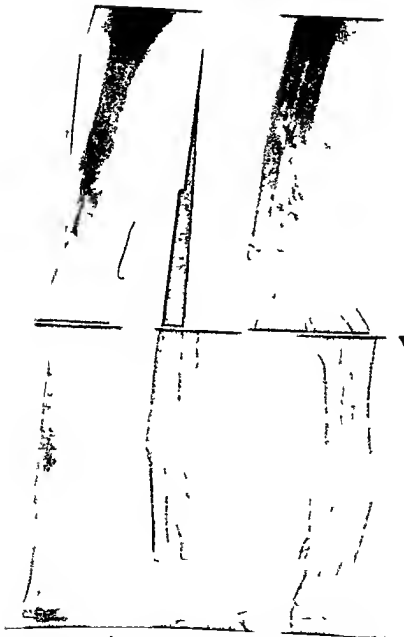


Fig 447—Compound comminuted fractures of the forearm with loss of bone substance of the radius bone. Fractures were treated by the Orr method and subsequently bone grafts were applied to the radius.

as described above. If there are several wounds present, each is treated in this manner.

(c) If more than twelve hours have elapsed since the fracture or if it is a frankly infected compound fracture, neither excision of the wound nor classical debridement should be undertaken. For this type of wound fracture, the establishment and maintenance of wide-open drainage is essential. The surgery must be kept within the confines of the wound. All foreign bodies and loose fragments of bones are removed as well as any grossly devitalized tissue. All pockets should be opened and no blind spaces should be present.

3 *Treatment of the Bone*—Loose fragments of bone must be removed, as should semidetached bone fragments, for they do not hasten union of the fracture. Moreover, if infection supervenes these fragments are extruded as sequestra. Grossly soiled bony ends are excised with rongeur and the medullary canal is inspected for foreign bodies. Bone fragments with the periosteum intact and good attachment to surrounding fascia or muscle should be left in situ. It has been our experience that these fragments of bone act as a scaffolding for the formation of new bone, especially in the "multifragmented" comminuted fractures (Figs 443 to 446). Perhaps these fragments supply available calcium and later are invaded by new vascular tissue which will lead to absorption and replacement of new bone.

4 *Reduction and Fixation of the Fracture*—Length must be restored



Fig 449 (Including facing page)—Through and through gunshot wounds, compound comminuted "multifragmented" fractures of the femur

stant irrigation with saline during the operation as we have felt that this may carry infection into uncontaminated tissue. Our preference is to use intermittent flushing with ether which has the additional advantage of acting as a solvent for certain foreign material and arresting minor oozing.

(b) When the wounds are deep and complicated, complete excision is contraindicated and careful débridement should be employed.



Fig 449 (For legend see facing page)



ment as far from the fracture site as possible—and the use of a fracture table or machine. Later these pins are incorporated in the plaster.

Perfect position or cabinet makers reduction is not necessary in order to have a good functioning limb but perfect or as near perfect fixation as is possible is essential. Motion at the fracture site not only delays union but constitutes continuing trauma to the wound and thus may contribute to the spreading of infection. We usually employ internal fixation especially in the tibia using vitallium plates and screws. However, plating wiring inserting clamps bands and the like are not to be undertaken lightly, and should be reserved for the experienced surgeon.

5 Joint Injuries—Our guiding principle in the treatment of all compound fractures of the extremities involving joints and penetrating wounds of the joints is closure of the joint capsule without drainage, *the remainder of the wound is packed wide open with sterile petrolatum gauze*. Prior to the closure of the capsule all foreign material and blood clots are removed and the joint cavity is gently irrigated with a small amount of ether and physiological saline solution. The jagged bone fragments or cartilage are curetted or chiseled out. By this process hemorrhage effusion the escape of synovial fluid and fistula formation are kept at a minimum.

6 Care of the Wound and Immobilization—We come now to the selection of the method to be used once the wound has been attended to and the fracture reduced and fixed directly or with position maintained by pins and traction. Several plans are available. The wound may be closed with or without drainage and the subsequent care be comes that of a closed fracture. This method has its advocates and many of them have reported brilliant results the experience of others has not been so happy. Others advocate the loose closure of the wound with provision for drainage by leakage. This method is inconclusive. Some employ the method of suspension and traction for the late case and incise and drain the wound only when it "ripens." Individual pockets of pus and degenerative tissue are incised and drained. This procedure is merely mentioned in order to condemn it. A number of patients thus treated were observed on Okinawa and the odor was unbearable. It had a cadaveric stench and was nauseating. Patients so treated became cachectic and toxic. The pus from the site of the wound usually spreads along the fascial spaces of the limb giving rise to numerous blind pockets of pus. The technique of Dakin Carrel is often

Fig. 450—Gunshot wounds of the shoulder girdle area with injury to the shoulder joint. Wounds of entrance excised and joints treated as described in the text. Foreign bodies removed by separate incisions.

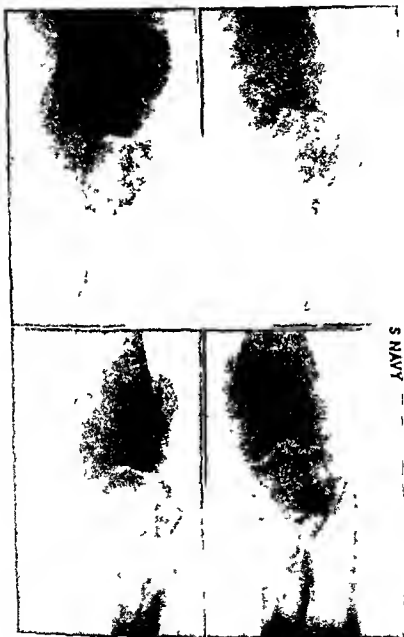


Fig 452.—Compound fractures involving the knee joint



used in the case seen too late for adequate debridement and where the operation upon the soft parts has been limited to the establishment of incision and drainage. The wound is left open and provision made for frequent dressings. This technic requires great care and attention. Moreover there may occur secondary hemorrhage from the action of the solution on the tissues. This method necessarily gives primary attention to the wound at the expense of the fracture. Our treatment of choice is the Orr method to be described.

7 Indications for Amputation—To make a decision to amputate when the patient is first seen may be very simple or may require considerable judgment. Often it will be necessary to wait until the patient is examined under an anesthetic. It is difficult to lay down rigid rules; however the general indications for amputations in compound fractures are as follows:

- 1 Complete loss of blood supply to the limb
- 2 Extensive destruction and laceration of skin and muscle with total loss of function of the limb
- 3 Uncontrollable infection endangering the life of the patient
- 4 Gangrene primary or secondary to thrombosis
- 5 Severest deformity and an artificial limb promises better function

THE ORR TREATMENT

Our treatment of choice for compound fractures is the Orr method viz the sterile petrolatum gauze pack and closed plaster encasement. The technic of this method consists essentially of the following:

- 1 Application of the aforementioned principles as outlined viz physical cleansing of the part, adequate excision or debridement of the wound, proper treatment of the bone fragments, reduction and fixation of the fracture, and the closure of the synovial membrane if a joint is involved.
- 2 A continuous roll of sterile petrolatum gauze is placed at the bottom of the wound next to the bone including all parts of the wound and leaving no recesses.
- 3 Sterile plain dry gauze dressings are placed over the petrolatum gauze pack.
- 4 Only bony prominences and joint areas are protected with gauze dressings.
- 5 A circular molded plaster cast is applied directly on to the skin and the wound.
- 6 The plaster encasement is not disturbed for four weeks.
- 7 At the end of four weeks the cast is removed and the wound is redressed under aseptic technic. Anesthesia usually is not required. The odor is like that of ripe Roquefort cheese at this first redressing.
- 8 The surface of the dressings under the plaster cast will be found with decomposed material, pus, secretions, sweat and the like. The

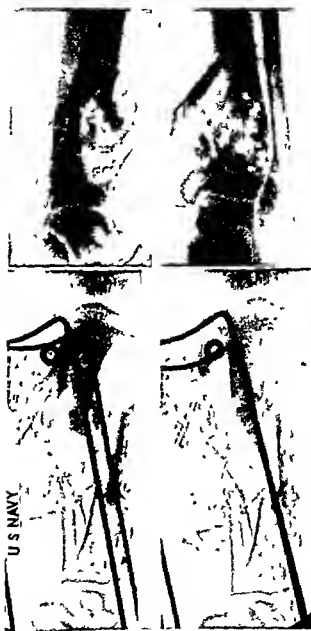


Fig 453—Above Compound fracture involving the ankle joint Below Through

used in the case seen too late for adequate debridement and where the operation upon the soft parts has been limited to the establishment of incision and drainage. The wound is left open and provision made for frequent dressings. This technic requires great care and attention. Moreover, there may occur secondary hemorrhage from the action of the solution on the tissues. This method necessarily gives primary attention to the wound at the expense of the fracture. Our treatment of choice is the Orr method to be described.

7 Indications for Amputation—To make a decision to amputate when the patient is first seen may be very simple or may require considerable judgment. Often it will be necessary to wait until the patient is examined under an anesthetic. It is difficult to lay down rigid rules; however, the general indications for amputations in compound fractures are as follows:

- 1 Complete loss of blood supply to the limb
- 2 Extensive destruction and laceration of skin and muscle with total loss of function of the limb
- 3 Uncontrollable infection endangering the life of the patient
- 4 Gangrene primary or secondary to thrombosis
- 5 Severest deformity and an artificial limb promises better function

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- 8 The surface of the dressings under the plaster cast will be found with decomposed material, pus, secretions, sweat and the like. The

area around the dressing is washed with soap and water. Upon removal of the petrolatum pack, healthy, pink and firm granulations of the wound will be found.

9 The granulating tissue is touched with sterile dry gauze.

10 If the wound is large, skin grafting is performed at this time or two weeks later. Otherwise, strips of sterile petrolatum gauze are placed on the wound and the entire limb is placed in a circular plaster cast for two to four weeks depending on the severity of the fracture and the bone involved.

Comment.—1 The plaster encasement is complete and circular.

2 The skin tight or unpadded cast is preferred because it does not exclude the free circulation of air and it affords direct drainage from the wound through the plaster and eventually to the outside. The odor is not as offensive as there is no absorption by any padded material.

3 Fenestration of plaster is condemned. It is unnecessary, encourages meddlesome dressings, produces edema and interferes with vascular circulation. Moreover, it deprives the fracture of support where most needed.

4 We do not advocate the secondary closure of these wounds on the fourth or fifth day. If the initial wound operation is complete as outlined, there is no need for direct inspection or revision. Furthermore, the secondary closure of a wound does not shorten the convalescent period of a patient with a compound fracture, in fact, it adds insult to the site of fracture.

5 Local implantation of sulfonamides or antibiotics is unnecessary. Systemically they are of benefit in limiting the extension of any existing infection and preventing secondary infection.

6 This contribution is intended as a renewal of previous endorsements of a method and a plea for its continued employment in spite of criticism from certain quarters. The principles were first advanced

and others trained in the same clinic in World War II.

TRAUMA TO THE FOOT AND ANKLE

J HAMILTON ALLAN, M D *

SPRAINS OF THE FOOT AND ANKLE

THE most common injury to the foot or ankle is a sprain of the lateral ligaments. It is important to differentiate between minimal damage to a ligament and a complete ligamentous rupture, for if the latter injury is not recognized and treated adequately healing does not occur and a painful relaxed ankle joint results. The lateral ligaments are composed of (1) the posterior talofibular, (2) the anterior talofibular, and (3) the calcaneofibular ligaments.

Moderate swelling, and slight tenderness over the talofibular and calcaneofibular ligaments indicate a simple sprain which may be ideally treated by rest in bed, elevation of extremity, ice packs, early active mobilization, and weight bearing with the aid of a Gibney boot strapping.

Considerable pain, swelling and acute tenderness distal and anterior to the tip of the lateral malleolus aggravated by adducting the foot suggest a ligamentous rupture. The detection of rotation of the talus in the ankle mortis, as the foot is adducted, is additional evidence of a rupture. A radiographic study is made to determine the integrity of the ankle mortis. In a normal anteroposterior roentgenogram of the ankle joint there cannot be a translucent zone between both talus and tibia and the talus and fibula. If such a zone is visible it indicates damage to the tibiofibular ligament with widening of the ankle mortis. If an anteroposterior roentgenogram of the ankle made with the foot passively adducted shows a luxation of the talus occurring in the ankle mortis (Fig 454) the lateral ligament is ruptured. This study can be satisfactorily done with the area of injury infiltrated with 1 per cent procaine.

If these studies indicate a complete rupture of the lateral ligaments the hematoma formed

is drained, a cast is applied and maintained for four to six weeks. The removal of the cast is followed by the application of an Unna paste boot or a Gibney boot strapping for ten days.

Sprains may occur elsewhere in the foot. Metatarsal sprains are common. There is swelling of the forefoot, acute tenderness under the metatarsal heads, and extreme discomfort upon flexion at the metatarsophalangeal joints. The recurrence of this type of sprain is often associated with contraction of the calcaneal tendon and calf

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muscle. It responds satisfactorily to the application of a felt pad just proximal to the metatarsal heads and a strong adhesive support about the forefoot. When the acute symptoms subside, a sponge rubber metatarsal support is inserted in the shoe and calf-stretching exercises are begun.



Fig. 454—Rupture of external ligaments of ankle demonstrated by the marked rotation of the talus in the ankle joint mortis upon inversion of the foot.

FRACTURES AND DISLOCATIONS OF THE ASTRAGALUS

The astragalus (talus) has seven articulating surfaces and articulates with four bones. It is the only bone in the body that has no muscular attachments. Its surface is largely covered by a nonvascular articular cartilage which responds poorly to trauma. The articular surfaces are weight bearing in function and are involved in all motions of the foot and ankle.

The vascular supply of the astragalus is derived from branches of the anterior tibial artery which enter the superior astragalonavicular ligament and supply the superomedial aspect of the neck of the astragalus. The blood supply to the body of the talus is impaired if a fracture occurs in the neck proximal to the nutrient artery. Similarly, if the fracture occurs distal to the entrance of the nutrient artery, aseptic necrosis is a possibility.

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... one fourth of
... ture occurs the
disability may be considerable, because it results not only from the fracture itself but from the serious complications which accompany

this injury (1) *Aseptic necrosis* occurs very frequently because of the inadequate blood supply to the talus (2) *Traumatic arthritis*, particularly of the tibiotalar joint, is rather constant because infraction of the cartilaginous joint surfaces is produced as a result of the impacting nature of the force causing the injury, and these cartilaginous surfaces do not heal satisfactorily (3) *Infection* of the talus causes marked damage and is a common complication for the reason that so many of these injuries are compound fractures

Fractures of the astragalus are divided into three groups (1) posterior process, (2) the neck, (3) the body

Fracture of the Posterior Process.—The posterior trigonal process is situated lateral to the groove of the flexor hallucis longus tendon and serves as an attachment for the fasciculus of the lateral ligament of the ankle joint. When the foot becomes plantar flexed, the posterior aspect of the talus rises upwards and approaches the lower margin of the posterior surface of the tibia. Impingement of the tibial margin against the posterior process during the action of acute plantar flexion of the foot causes the fracture

Diagnosis is made on the basis of an acute plantar flexion force, localized tenderness, pain with plantar flexion of the foot and on acute flexion of the great toe. The fracture is not a serious one, being outside the joint, however, it is of considerable medicolegal importance because of the necessity of distinguishing between a fracture and the os trigonum. The latter is a developmental variation found in 10 per cent of normal individuals. Roentgen study of a fracture of the posterior process reveals soft tissue swelling and a sharp irregular fracture surface as contrasted to the smooth regular outline of the os trigonum. The fracture heals satisfactorily with a six week period of fixation in plaster with the foot in neutral position.

Fracture of the Neck.—Fracture of the neck of the astragalus is a dorsiflexion injury. It occurs as the neck of the talus is impacted against the anterior margin of the tibia, which is forced downward into the talus causing a vertical fracture. It is unusual to see a vertical fracture of the neck without displacement. So often is it associated with a posterior displacement of the posterior half of the subtalar joint that a fracture of the neck of the talus calls for a careful search for the posterior displacement.

If there is no posterior displacement the treatment is immobilization in a cast for eight weeks. If there is the slightest suggestion of posterior displacement of the posterior half of the talus, the foot must be immobilized in plantar flexion and eversion, because only in this position is the alignment of the head and body of the talus to the calcis satisfactory. This position is maintained for eight weeks, then followed by a cast with the foot less dorsiflexed. Three weeks later the foot is brought to the neutral position and plaster immobilization is continued for four weeks.

Fracture of the Neck of the Talus with Posterior Displacement of the Body—This is an extreme dorsiflexion injury. Not often seen in civilian life, it proved to be a rather anticipated injury in aircraft accidents during the war. During a crash the rudder pedal forces the foot of the pilot into acute dorsiflexion, fracturing the neck of the talus with the line of injury extending to the ligaments of the posterior part of the subastragalar joint causing a posterior displacement of the body of the talus. As the body of the talus is displaced, all soft tissue attachments are torn. The bone is thus deprived of its blood supply and avascular necrosis should be anticipated.

This type of injury is extremely difficult to reduce. It is imperative to attempt an immediate closed reduction, for the extreme displacement of the body of the talus causes severe pressure on the under surface of the skin, and there is danger of compounding from within. The foot is manipulated into full dorsiflexion, the heel pulled forward then everted to unlock the sustentaculum tali, and finally, while pressure is maintained on the posterior part of the body of the talus to prevent redisplacement, the foot is brought into plantar flexion.

If this manipulation is not successful open reduction is indicated immediately. A lateral incision along the ankle at the level of the subtalar joint is brought obliquely forward toward the talonavicular joint. The subastragalar joint is exposed, the sustentaculum tali and talus are unlocked and the talus pushed forward into position. The incision is closed with drainage and the foot is placed in a cast.

Fractures of the Body.—Fractures of the body of the talus are usually comminuted and are accompanied by dislocation of the fragments into the soft parts in front of and behind the ankle. The posterior segment of the body may lodge beside the calcaneal tendon and the anterior segment may be rotated and thrown anteriorly. These fractures cannot be reduced by a closed manipulation and an open reduction should be done as early as the damaged soft parts are in good enough condition for surgery. Here again after the fragments are replaced into position fixation is secured by insertion of Kirschner wire. The incisions are closed with drainage and the foot is placed in a cast.

and if it is present full weight bearing should be delayed until the bone has a normal appearance.

In comminuted fractures of the astragalus astragalectomy is often done. It should be emphasized that this procedure is attended by serious disability. While it has been successful in a few cases the majority of results have been disappointing. The technic of astragalectomy was devised for paralytic calcaneovalgus foot where there is usually a muscle weakness in the plantar flexors and adductors of the

foot In the traumatic lesions of the talus there is no muscle imbalance It is difficult to balance the adult foot between the malleoli and the foot usually goes into varus thus producing a crippling deformity

The best functional results occur from those astragalectomies which will be followed by fusion of the tibia and os calcis This fusion is to be expected as a sequel to infection and astragalectomy is performed without hesitation when an infected talus has to be removed before healing will occur In this event fibrosis or ankylosis occurs limiting the motion between ankle mortis and articulating surface of the os calcis and if the foot can be maintained in a satisfactory position during the period of fibrosis a satisfactory foot will result

Occasionally astragalectomy has to be performed where comminution of the talus is extreme In such instances the foot should be maintained well forward where the anterior margin of the tibia is in a vertical plane with the calcaneocuboid joint A calcaneotibial arthrodesis should be done and the foot placed in equinus of 5 degrees in males and 10 to 15 degrees in females

With the exceptions of the two indications cited above—infection and extreme comminution of the talus—other surgical procedures are preferable to astragalectomy Where the astragalus has been comminuted the blood supply seriously disturbed and the many fracture lines cause a disruption of the articular surfaces a subastragalar arthrodesis an ankle fusion or a pantalar arthrodesis may be done It does not seem reasonable to do these procedures early The patient should be allowed a test of function for about a year in order to determine which joints should be fused A surgical arthrodesis of the painful articulations yields a painless and stable weight bearing foot

Dislocations of the Talus—Dislocations of the talus are classified by the direction of the displacement Three distinct groups are evident (1) supination (2) dorsiflexion (3) adduction and abduction In each group the type of displacement depends upon the force involved

Inversion of the foot causes rupture of the lateral ligament dislocation of the ankle joint and if strain continues the interosseous ligament of the subtaloid ruptures allowing the talus to stay in the tibiofibular mortis but the other tarsal bones dislocate inward This is the *subastragaloid dislocation* The talus remains in an equinus position In reducing this dislocation the foot is plantar flexed then everted and abducted The ankle is immobilized for six weeks in a walking plaster with the foot in right angled dorsiflexion and neutral lateral position It must be borne in mind that by the very nature of injury a dislocation of the ankle is associated and this must be likewise reduced satisfactorily

If the inversion force is very violent and associated with plantar flexion the talus becomes rotated 90 degrees about its vertical and long axis as the subtaloid dislocation occurs If as the displacing force

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condition. The fragments are reduced and fixed with a Kirschner wire. The foot is placed in plantar flexion and the

avascular necrosis is prevented by the use of antibiotics until the

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In *midtarsal dislocations* the most frequent injury is the adduction form and is very often associated with a fracture of the navicular. The medial displacement at the midtarsal joint caused the navicular to be displaced dorsally and medially to the talus and the cuboid medially to the calcis. The history is of a severe wrenching of the foot following a fall from a height. Reduction is obtained by applying traction in the direction of the force which produced the injury. Closed reduction is frequently impossible due to the interposition of the anterior tibial tendon, a capsular ligament or fragments from the fracture of the navicular. Exposure of the talonavicular joint through a dorsomedial incision and the removal of all interposing tissue from the joint space allows the dislocation to be reduced. Position is thereafter maintained by plaster cast immobilization for eight weeks.

Dislocation at the tarsometatarsal joint (Lisfranc's joint, Fig. 455) is an injury produced by a fall from a height on a plantar flexed and inverted foot, or a plantar flexed and everted foot. Frequently the dislocation can be reduced by a closed manipulation followed by fixation in plaster. Open reduction is usually required because the interposition of fractured fragments of the base of the metatarsal or cuneiform bones prevents an adequate reduction. When reduction is obtained by surgery, difficulty arises in maintaining the reduction because of the relaxation and tearing of the joint capsules and because the flatness of the joint surfaces allows subluxation to recur. The insertion of a temporary Kirschner wire through the first metatarsal-cuneiform joint holds the position nicely, and this is maintained by plaster cast immobilization for six weeks. The Kirschner wire is removed through a small incision. An Unna paste boot is used as a supporting dressing for a short time.

METATARSAL FRACTURES

Fractures of the Neck of the Metatarsal—These fractures occur as the result of direct trauma such as a heavy object falling on the foot. The metatarsal heads are usually displaced into the sole, and if the displacement is not accurately corrected severe metatarsal discomfort results. If the displacement is not pronounced it may be reduced by traction applied to the toes by means of a banjo splint incorporated in a plaster boot. The traction is maintained for four weeks. A molded leather shoe is worn. The foot is placed in a boot of sponge rubber.

If the displacement is pronounced, reduction is obtained by traction or if in a case presenting several fractures the impossibility of reducing one of the fractures may compromise the result obtained in others open reduction is done. At operation skin incisions are made with special care to avoid the pressure points of the foot. A dorsal longitudinal incision is usually made midway between each pair of fractured metatarsals so that two fractures may be exposed with each

is spent, the talus becomes **locked** in its rotated position a *total dislocation of the talus* results. This injury is caused by such extreme force that it is usually **compounded**. Reduction is secured by reproducing the deformity which caused the injury, namely, inversion and plantar flexion, then by pressure over the posterior surface of the talus thrust backward and inward. Here again, because the talus has been *deprived of its soft tissue attachments, and thereby its blood supply* there is grave danger of **aseptic necrosis**. The leg is immobilized in



Fig. 455—Complete lateral dislocation at Lisfranc's joint requiring open reduction and removal of fractured fragments between the base of 2nd and 3rd metatarsal

neutral position in a cast for twelve weeks. Nonweight bearing is continued for at least six months because of the fear of impeding the slow process of revascularization.

Dorsiflexion injuries causing dislocation of the astragalus are always associated with fractures of that bone and have been previously described under fractures of the astragalus.

Abduction and adduction injuries cause (1) midtarsal dislocation (Chopart's joint) and (2) tarsometatarsal dislocation (Lisfranc's joint).

In midtarsal dislocations the most frequent injury is the adduction form, and is very often associated with a fracture of the navicular. The medial displacement at the midtarsal joint caused the navicular to be displaced dorsally and medially to the talus and the cuboid medially to the calcus. The history is of a severe wrenching of the foot following a fall from a height. Reduction is obtained by applying traction in the direction of the force which produced the injury. Closed reduction is frequently impossible due to the interposition of the anterior tibial tendon, a capsular ligament or fragments from the fracture of the navicular. Exposure of the talonavicular joint through a dorsomedial incision and the removal of all interposing tissue from the joint space allows the dislocation to be reduced. Position is thereafter maintained by plaster cast immobilization for eight weeks.

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If the displacement is stubborn and does not respond to traction, or if in a case presenting several fractures the impossibility of reducing one of the fractures may compromise the result obtained in others, open reduction is done. At operation skin incisions are made with special care to avoid the pressure points of the foot. A dorsal longitudinal incision is usually made midway between each pair of fractured metatarsals so that two fractures may be exposed with each

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metatarsocuneiform joint, and varying degrees of pes cavus. These congenital features lead to the fatigue and exhaustion of the supporting structures of the foot, and the resulting bone stress induced by a long march produces the fracture. The patient customarily notices pain in the forefoot during the long march. This is of a dull, aching, burning character, which slowly increases in intensity, and swelling of the forefoot follows. The patient begins to limp and hold the forefoot rather rigidly. Localized tenderness is present at the fracture site, and pain is experienced upon plantar flexion or traction on the corresponding toe.

As the onset of symptoms a roentgenogram of the painful forefoot may be completely negative for fracture. Usually by the tenth day after the initial complaint, there is evidence of a fracture line or some early callus formation. After three weeks the callus forms a spindle shaped mass about the fracture line. The second metatarsal is the one most frequently affected, and, as might be expected, the third is the next most frequently involved.

The preventative aspects of treatment should be stressed. The forefoot of the ordinary shoe is very flexible, and slowly it begins to bend upward at the metatarsophalangeal area. Hence, the use of a shoe with a fairly rigid forefoot, and the avoidance of short shoes are measures which will prevent this fracture from occurring.

In treating these patients it is, therefore, important to eliminate motion at the metatarsophalangeal joint. This is done by counter-sinking a steel bar $\frac{1}{2}$ inch wide, $\frac{1}{8}$ inch thick and 6 inches long into the sole of the shoe. A soft sponge rubber longitudinal arch pad is inserted into the shoe to balance the foot properly. Whirlpool bath treatments are given regularly until the soreness disappears. After six to eight weeks the fracture is usually healed. The steel bar in the shoe is removed and a small transverse metatarsal bar is substituted, and exercises are given to mobilize the metatarsophalangeal joints.

FRACTURES OF THE OS CALCIS

Fractures of the os calcis account for about 2 per cent of all fractures. They are the most disabling injuries in the realm of fractures. They occur almost exclusively in working men in whom the long period of disability is of vital concern. The injury is due to a fall in the upright position with impact of the heel against the ground. The force of the body weight driving downward causes the talus to be wedged into the calcis, compressing the bone and distorting the subtalar joint space. Due to the mechanism of the injury a fracture of the spine is so often associated with a fracture of the os calcis that the presence of one injury necessitates the exclusion of the other injury.

Clinically the injury is suspected if the patient has sustained a fall

incision. A Kirschner wire is passed as an intramedullary wire through the distal fragment from the fracture line and with the toe in extreme dorsiflexion is continued through the head of the metatarsal to emerge through the skin overlying the metatarsal head on the plantar surface of the foot. The wire is withdrawn until its proximal end is at the fracture site. The fracture is reduced. A drill is applied to the distal end of the wire and the wire is guided up the intramedullary space of the proximal fragment to the base of the metatarsal. The distal end of the wire is cut off so that it lies just beneath the skin and can be readily identified. At the end of four weeks a small nick in the skin made under local anesthesia at this site permits the removal of the wire. The molded leather arch support is then fitted to the foot and weight bearing is commenced.

For fractures with very minor displacement the leather arch supporting insole is strapped to the foot with adhesive tape and the patient is permitted to begin weight bearing immediately. If this results in too much discomfort a transverse bar is placed under the shoe in a slightly oblique position at a point about $1\frac{3}{4}$ inch in front of the heel. This bar eliminates painful pressure on weightbearing. Walking in a plaster cast permits uniform pressure to be distributed throughout the foot and the metatarsal arch becomes flattened out and broadened. With the use of a molded arch support and a transverse shoe bar normal toe action tends to preserve the normal form and muscle balance of the metatarsal area. Within three weeks the strapping may be removed from the foot and the arch support inserted in the shoe. At the end of the fourth week whirlpool treatments and active exercises are given to increase the mobility of the metatarsophalangeal joints.

Avulsion Fracture of the Base of the Fifth Metatarsal Bone—This is a common and important fracture. The peroneus brevis tendon is inserted into the base of the fifth metatarsal and a severe inversion strain of the foot throws the entire weight very suddenly on the outside of the foot causing an avulsion of the tendon with a fragment of bone. Local tenderness, swelling and pain aggravated by inversion

extremely slow. The foot is immobilized in eversion and nonweight bearing is continued for six weeks.

March Fractures of the Metatarsals—A march fracture is a fissure fracture due to stress which commonly occurs in the neck or shaft of the second, third or fourth metatarsal. It occurs during prolonged marching or in speed marching so often called for in basic military training.

The predisposing constitutional factors are varus of the first metatarsal, shortening of the first metatarsal, increased flexibility of the first

flexing the foot and applying pressure over the upper surface of the fragment. A walking plaster is applied with the ankle in a few degrees of plantar flexion. Plaster is removed after six weeks and an Unna paste boot applied. Where reduction is not possible and separation continues to be wide, open reduction is done and a screw inserted across the fractured surfaces, thus approximating the fragments. The extremity is immobilized in plaster for six weeks.

Fractures of the sustentaculum tali with separation requires the use of lateral compression with a compression clamp followed by plaster cast immobilization in neutral position for six weeks.

Comminuted Fractures with Minimal Joint Injury.—In the second group of calcis fractures those fractures of the body without displacement of the joint surfaces articulating with the talus, in which there is no crushing of joint surfaces, widening of the tuberosity or reduction of the tuber joint angle, heal satisfactorily if immobilized in plaster cast for six weeks.

To this same group, however, belong 25 per cent of fractures of the os calcis in which there is a fracture of the outer wall and body with reduction of the tuber-joint angle. The treatment of this injury requires (1) lateral compression to prevent impingement under the external malleolus, and (2) plantar traction of the posterior aspect of the os calcis to restore tuber joint angle. This corrects relative lengthening of the calcaneal tendon and reduces the subluxation of the posterior subastragalar joint.

This reduction is accomplished by the Stader splint or the Zimmer reduction frame. The reduction is delayed until primary swelling has begun to subside. Spinal anesthesia is used. The injured leg is compared with the normal one, as a check of the reduction.

When the *Stader splint* is used, a stainless steel pin attached to a U shaped bar is inserted through the most superior posterior portion of the os calcis. Two similar pins secured to each other by a pin bar are passed through the lower end of the tibia. Turnbuckle lateral bars connect the pin to the U bar and the activation of the turnbuckle bars brings about distraction and reduces the tuber joint angle to normal. The os calcis is then compressed laterally by the use of a Bohler compression clamp until the width of the os calcis is similar to the width of the normal calcis. X rays are taken immediately and further adjustments are made if indicated. Exercise of the toes and knee is commenced immediately, and the patient is allowed to be up. Immobilization in the *Stader splint* is continued for eight weeks. When the splint is removed nonweight bearing is continued for a period of four weeks during which time whirlpool, gentle massage and active exercise are carried out. Weight bearing is then commenced using a molded arch support, or if necessary a transverse bar attached to the shoe, as outlined for metatarsal fractures.

The same principles of reduction are used in the *Zimmer fracture*

on his feet from a height and complains of pain in the heel. The heel is extremely tender to pressure. There is marked swelling and ecchymosis. There is noticeable broadening of the heel and very limited painful motion is noted in the subastragalar joint.

These fractures fall into three general groups:

1 *Isolated fractures without joint injury*. These include vertical fractures of the tuberosity, horizontal or "beak" fractures, and fractures of the sustentaculum tali.

2 *Comminuted fractures with minimal joint injury*, such as the fissure fracture without displacement, and the fracture of the outer wall and of the body with reduced tuber joint angle but no crushing of the joint.

3 *Comminuted fractures with severe joint injury* causing displacement, reduction of the tuber joint angle with fracture of the outer wall and body, fracture of the posterior and anterior articular surface.

Careful roentgenographic study is of extreme importance. A lateral and anteroposterior view of both feet and axial views of both heels are taken. In taking the axial view a strip of gauze bandage is placed in a loop about the anterior arch of the foot with ends held by the patient. The foot is drawn into moderate dorsiflexion. The film is placed underneath the heel and the lower leg. The x-ray tube axis is directed on to the plantar surface of the heel at an angle of 45 degrees. The x-ray will record the amount of comminution, the lateral expansion of the heel, the condition of the talocalcaneal joint, the condition of the sustentaculum tali, the presence or absence of the midtarsal joint subluxation and the tuber joint angle of the calcaneus.

The tuber joint angle measures the degree of upward displacement of the tuberosity. This is the angle formed by the dorsal surface of the tuberosity with the projected line of the subastragaloid joint. In the normal foot the angle measures about 40 degrees, but when the tuberosity is displaced it is greatly reduced.

The principles of treatment as outlined by Böhler are the basis of the current management of these fractures. The tuberosity must be pulled downwards until the tuber joint angle is restored and back

to its full length, even if the tuber joint angle is not restored.

apply lateral compression to reduce the lateral impaction under the external malleolus and the expansion or lateral displacement of the body of the calcus.

Isolated Fractures without Joint Injury—In the first group of isolated fractures of the calcaneus the following procedures are used. The displacement, if present, in the vertical fracture of the tuberosity is corrected by a compression clamp. A walking plaster is applied for six weeks and subsequently a gelatin boot for a longer period of time. In the horizontal beak fractures, displacement is corrected by plantar

ture of the outer wall and body, reduced tuber-joint angle and displacement and crushing of the posterior articular surface or the anterior articular surface. When the articular surfaces are fragmented and separated a vascular necrosis is due to occur. Because of the painful stiffness of the subastragalar joint which will eventually result, a triple arthrodesis of the subtalar and midtarsal joints is indicated. In our hands subastragalar arthrodeses have not been done early because many badly crushed fractures have yielded upon reduction a better functioning foot than x ray appearances would indicate, and a foot with less permanent disability than would be present with a triple arthrodesis. Hence in these borderline cases, if weight bearing proves unsatisfactory following an adequate test of function, a subastragalar arthrodesis is done (Fig 456).

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reduction apparatus A Steinman pin is inserted through the lower end of the tibia and another through the superior posterior portion of the os calcis. The horseshoes of the apparatus are adjusted to receive each pin. By lowering the distal horseshoe extension traction can be applied in a downward and backward direction in the long axis of the calcaneus. The os calcis is compressed laterally by a Bohler clamp until the widening of the calcis has been completely reduced.



Fig. 456—Old fracture of the os calcis with aseptic necrosis and traumatic arthritis of the talocalcaneal and calcaneocuboid joints. Triple arthrodesis done to eliminate painful weight bearing.

Sterile gauze dressings are spiked over the pins held in place by sheet wadding and a circular cast is applied from below the knee to beyond the toe incorporating the pins snugly in the cast. Subsequent treatment follows the schedule indicated above.

Comminuted Fractures with Severe Joint Injury—Fifty five per cent of fractures of the os calcis unfortunately fall into the third group in which the fractures are comminuted with severe joint injury frac-

urologists, and particularly Lanois, believed it to be a counterpart of arteriosclerosis. The famous pathologist Virchow regarded it as a true tumor formation. The inflammatory theory held sway for awhile in the minds of many investigators and the most recent and plausible theory bases its explanation on the supposition that the gland enlarges at a time of life when sexual activity is on the wane and that hypertrophy takes place as a compensatory effort on its part to supplant the diminishing sexual function. Age, however, is the ever present and predisposing factor, and while many men in their late forties are frequently seen with extremely large hypertrophied glands, the 55-65 age period is the time in which cases are most frequently encountered.

Pathology—Benign hypertrophy of the prostate gland occurs most frequently in the middle and lateral lobes, rarely in the anterior lobe and practically never in the posterior lobe. Various combinations may take place as hypertrophy of the lateral lobes, middle and lateral lobes, middle lobe alone and the median bar enlargements. All of the types may cause troublesome vesical neck obstruction as evidenced by the common symptoms of nocturia, frequency of urination, difficulty in starting the stream, great urgency, particularly with the advent of cystitis and finally complete retention of urine.

A pertinent question might well be asked at this point as to what constitutes benign prostatic hypertrophy. The pathologist microscopically recognizes (a) a glandular type in which tubules are in great preponderance, and so greatly distended that the interstitial tissue is greatly diminished, (b) fibroglandular in which there is a great amount of fibrous tissue between the distended tubules and is the basis for the formation of adenomas, (c) fibrous, which is characterized by an overgrowth of connective tissue with compression of the tubules, and (d) cystic, in which the tubules and acini have been gradually distended and surrounded by layers of fibromuscular tissue. The hypertrophied gland in 30 to 40 per cent of males eventually becomes an obstructive process and it has been most aptly said that hypertrophy of the gland does not kill the patient per se, but it is the secondary pathologic changes that are death producing in the well established sequence of partial to complete urinary continence, vesical diverticula, calculus formation, hydronephrosis and hydronephrosis with stasis of urine, infection and, finally, as a result of the long standing interference with the elimination of urine, the picture of uremia.

Diagnosis—The diagnosis is readily made by finding on rectal examination an enlargement of the prostate gland in the patient in the middle decades of life presenting the classical symptoms of nocturia, frequency of urination, difficulty in starting the urinary stream and loss of its parabolic curve. Cystourethroscopy, cystographic visualization x-ray, excretory urography and cystometric determinations will reveal the amount of residual urine, the exact type of prostatic enlargement and any additional pathological change in the bladder as

SURGERY OF THE PROSTATE GLAND

JOSEPH C. BIRDSALL, M.D.*

THE prostate gland is functionally so closely related to the male genital organs that it is most appropriately regarded and classified as one of the accessory glands of the sexual reproductive system.

Anatomically and clinically it is described as consisting of a middle and two lateral lobes which surround that portion of the urethra designated as the prostatic urethra. Structurally the prostate is a gland of the tuboalveolar type and consists of a connective tissue framework, involuntary muscle and glandular tissue. Embryologically, while the prostate gland of the male and the uterus of the female cannot be regarded as homologous organs, they are quite similar in histologic structure and would be most strikingly alike if the tubular glands found in the inner walls of the uterus were prolonged into the muscular substance. The development of the prostate gland begins about the twelfth week of embryonic life and Lowsley's detailed studies show that at this time the prostate is composed of five distinct parts of five groups of tubules. In the prostatic capsule, there eventually develop five lobes, a middle, right and left lateral, posterior and anterior lobe. The tubules of the anterior lobe gradually decrease in size and number and at birth only a few tubules are present. The posterior lobe tubules occupy that section of the gland described as the apex and consist of that portion which is readily palpable by rectal examination. While benign prostatic hypertrophy is said rarely to develop in the posterior lobe it is extremely significant, as primary carcinoma is more likely to stage its origin in this section than in any other portion of the gland, and its position is most favorable for early detection by the alert clinician who recognizes that the earliest possible diagnosis is most essential for its complete or total extracapsular extirpation.

The most common pathologic entities of the prostate which require surgical intervention are (a) benign prostatic hypertrophy, (b) malignant involvement, (c) prostatic calculi and (d) abscess formation.

BENIGN HYPERTROPHY OF THE PROSTATE GLAND

Various theories have been advanced in an attempt to explain the cause of hypertrophy of the prostate gland. The French school of

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in urination, pyuria, large amount of residual urine, high blood urea and poor renal function are the immediate "poor risk" cases and their operability is dependent upon proper medical care and establishment of urinary drainage.

A complete history, physical examination, the blood picture, sugar, urea coagulation time, bleeding time, serology, carbon dioxide determination, tests of renal function and excretory urographic studies are basic preoperative procedures. Systemic complications, diabetes,

urethral catheter or by the first stage suprapubic cystostomy drainage and is confirmed by the index of elimination. One half cubic centimeter of phenolsulfonphthalein is given the patient intravenously and three twenty minute collections of urine are obtained per catheter. The percentage amount eliminated in each period is estimated and the index of elimination is determined by dividing the percentage amount eliminated in the first period by the percentage amount eliminated in the third period. Whenever renal function has so improved that the percentage amount eliminated in the first period exceeds that eliminated in the third period operability of the patient is considered favorable. Our preference is the utilization of the indwelling catheter for the attainment of satisfactory urinary drainage and renal function but in many instances due to urethritis, marked cystitis, vesical calculi and tumor, the urethral catheter is not tolerated. Also in patients in whom prior to admission repeated unsuccessful attempts have been made to pass catheters—rubber, woven and metal—followed by chills and fever, suprapubic drainage is by far the best method of choice.

Factors Determining the Choice of Operation.—Many urologists who have been trained under preceptors of either the suprapubic or perineal prostatectomy technics continue to prefer those approaches and their results are excellent. However, since the advent of transurethral prostatic resection and the cautery punch or the cold punch types, many prefer and use these methods to the exclusion of all other procedures. Prostatic obstruction per se should not be the sole factor in the choice of method of operative intervention but a differentiation of the type of obstruction and the determination of associated vesical disease should be positive factors in making a decision as to the route particular type of operation, and the attainment of lessened morbidity and mortality.

Choice of Anesthesia.—The skilled and well trained anesthetists of today work in close collaboration and cooperation with the medical consultants and cardiologists whose opinions are sought and accepted as regards the choice of anesthesia and have, with the great wealth of choice in anesthetics, a type of anesthesia suitable for practically every patient and condition. For the average case with no cardiac

vesical calculus, diverticulum, papilloma, papillary carcinoma, prostatic calculi, renal complications, and neurogenic disturbances, any or all of which, when present, are as important as the hypertrophied gland itself and the preoperative determination of their presence is most essential in the proper management of the patient with hypertrophy of the prostate gland

Cysto urethroscopy reveals the exact type of prostatic enlargement—



Fig 457

Fig 457—Cystographic study shows large diverticulum of bladder complicating hypertrophy of the prostate gland



Fig 458

Fig 458—Cystography reveals bilateral ureteral reflux with rather marked bilateral hydronephrosis complications of prostatic hypertrophy

cedure in the individual case. In the present progressive era of high attainment of medical skill and surgical technique the prospects of qualified patients with prostatic hypertrophy are infinitely better for obtaining a complete and permanent functional result from operative procedure than from any form of hormonal palliative treatment or intermittent or permanent catheter life.

Preoperative Qualifications.—Many patients with prostatic obstruction who seek early medical advice are found in many instances to fulfill all of the qualifications for immediate surgical intervention. The patients, on the other hand, with the history of long standing difficulty

fascia and also by an inner or true capsule of thin fibrous tissue intimately connected with the gland substance and in suprapubic prostatectomy as performed by his technic the true capsule with the enclosed hypertrophied gland is removed leaving behind the outer capsule. The general consensus at the present time is that hypertrophy arises from accessory glands or tubules and not from the prostate gland per se which undergoes atrophy from pressure and this gland atrophy forms a capsule of prostatic tissue out of which the hypertrophied accessory glands and tubules can be enucleated. However the experienced operator whether he chooses the suprapubic or perineal approach readily finds a distinct line of cleavage which facilitates the removal of the obstructing hypertrophied tissue.

Suprapubic Prostatectomy—A midline hypogastric incision is made beginning at the upper border of the symphysis pubis and extending upward for 4 or 5 inches. The sheath of the recti muscles is incised the recti muscles separated and the thin layers of transversalis fascia preperitoneal fat and peritoneum is gently elevated upward and well out of the operative field. The bladder which has been previously irrigated with an antiseptic solution and filled by means of the indwelling catheter left in situ is readily recognized by its globular appearance and in particular by superficial veins. It is now grasped by an Allis forceps on each side of the midline and its wall is incised. A suction tube is now inserted and with well trained assistants and good team work the fluid from the bladder is evacuated with little or no contamination of the operator's field. The incision is now enlarged inspection of the bladder completed and the end of the catheter brought out through the suprapubic incision. The catheter stays in position in the urethra during the operative procedure and is utilized for insertion of the Filcher hemostatic bag at the completion of the enucleation of the prostate.

The intraurethral enucleation of the prostate gland as described by Squier is now undertaken by inserting the index finger into the prostatic urethra between the lateral lobes. With the catheter pushed aside the finger readily breaks through the mucous membrane of the roof of the urethra and immediately finds access to the line of cleavage between a lateral lobe and its adjacent capsule. When once the proper line of separation is found the finger continues to separate in the line of cleavage the left lateral lobe median and right lateral lobes and often the whole three lobes are removed en masse. Inspection of the prostatic bed is now thoroughly made to ascertain the possibility of having left behind a small adenoma which embedded later on could by enlarging cause obstruction. A finger inserted into the rectum helps in certain cases with fat abdominal walls to elevate the prostate so that it can be more readily accessible to the operator's enucleating finger. Loose tags around the prostatic bed are now removed and if there is hypertrophy of the interureteric ridge or liga

complications, we prefer low spinal anesthesia for suprapubic prostatectomy, as it gives complete abdominal wall relaxation. Low spinal or caudal is also excellent for perineal prostatectomy. For the extremely apprehensive patient avertin works admirably. Pentothal sodium is excellent for uncomplicated cases of suprapubic prostatectomy, punch operations, and transurethral resection, and supported by cyclopropan

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the use of open drop ether, while in other cases it can be maintained by preliminary ephedrine medication. As a rule, this is the choice of anesthesia recommended by the cardiologist in cases of coronary disease and in the patient with hypertension and in those cases with a history of cerebral catastrophe.

Indications for Prostatectomy.—Increasing difficulty in voiding compels many patients to seek medical aid, and often the expression, "something has to be done as I cannot continue to live this way," is heard. Inability to void is the only compelling reason for some individuals to consult their physician. However, many patients having been made at least "prostate conscious" by some of the less extravagant magazine publications, seek advice early and their cases can be properly evaluated. Residual urine of 3 or more ounces which cannot be lessened by palliative measures as prostatic massage or maximum dilatation by means of sounds, marked infection in the prostatic tubules and acini, pain and dysuria are definitely indications for surgical intervention.

When the prostate has reached that stage of enlargement in which surgical intervention is indicated, there are three approaches which are to be considered, (a) the suprapubic, (b) the perineal and (c) the transurethral. Anatomically the suprapubic approach is less diffi

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cystostomy has been performed for preoperative drainage should be completed through this route. Finally, the functional acts, urinary and sexual, are less disturbed and better preserved by suprapubic prostatectomy and the operator with great assurance can satisfy the interrogations of the patient who raises the questions as to postoperative incontinence and impotence.

The question as to what constitutes prostatectomy has been the subject of much discussion and has led to the expression of various opinions. Freyer, in particular, regarded the prostate as being encased in an outer capsule formed by the visceral division of the pelvic

fascia and also by an inner or true capsule of thin fibrous tissue intimately connected with the gland substance, and in suprapubic prostatectomy, as performed by his technic, the true capsule with the enclosed hypertrophied gland is removed, leaving behind the outer capsule. The general consensus at the present time is that hypertrophy

accessory glands and tubules can be enucleated. However, the experienced operator, whether he chooses the suprapubic or perineal approach, readily finds a distinct line of cleavage which facilitates the removal of the obstructing hypertrophied tissue.

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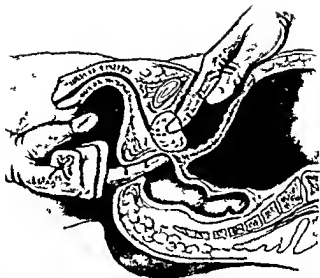


Fig. 459.—In most suprapubic prostatectomy cases enucleation of the prostate is readily accomplished with the index finger after the technique as described by Squier. In cases with thickened abdominal walls a finger in the rectum and the use of the middle finger for enucleation often facilitates the removal of the prostate gland.

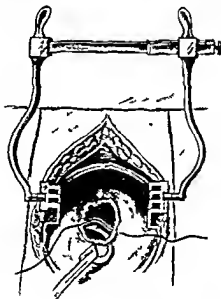


Fig. 460.—Excess bleeding may be controlled by sutures inserted by use of Young's boomerang needle following suprapubic prostatectomy.

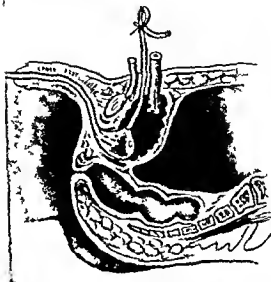


Fig 461—Excess bleeding is also controlled by insertion of a Pilcher bag which may be inflated by air or by sterile water

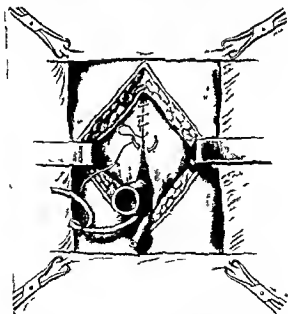


Fig 462—Illustration of drainage tube in the space of Retzius and large bladder drainage tube which is anchored by suture of plain cat gut to upper angle of incision in bladder and also to skin at lower angle of median hypogastric incision

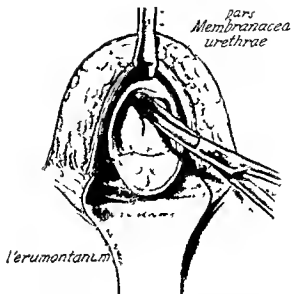


Fig. 463—Scissors cutting through the membranous urethra at its junction with the prostatic urethra (Elmer Belt)

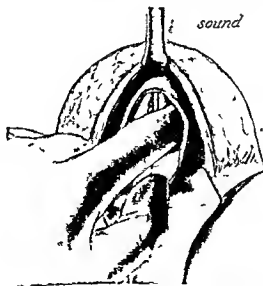


Fig. 464—Lateral lobes of the prostate being shelled out of its capsule (Elmer Belt)

ment with a deep bas fond a V shaped wedge of tissue is removed from its central portion

Many methods have been utilized for the control of bleeding from the prostatic bed gauze packs mattress sutures through the edges of the prostatic capsule closing of prostatic bed with a urethral catheter in situ for drainage as advocated by Harris and various types of hemostatic bags and most recently oxycel The Pilcher bag is used in most clinics routinely as it is constructed about a tube which takes the place of a catheter when the bag is deflated The end of the Pilcher

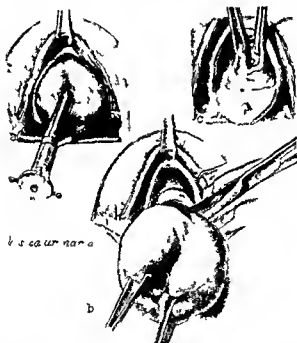
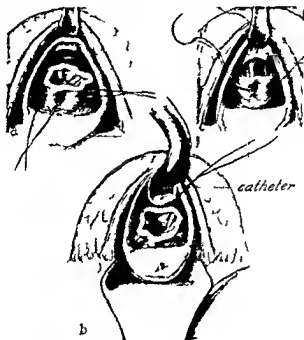


Fig 465 a Prostatic tractor inserted b prostate being cut free from bladder neck c prostate removed bleeding from bladder neck controlled by Allis forceps (Elmer Belt)

bag tube is sutured to the tip of the catheter and by traction on the catheter the bag is drawn into the prostatic bed and distended with water by means of a tube attached to and continuous with the interior of the bag The bladder is now closed around a large drainage tube and the space of Retzius drained by means of a small rubber tube drain Traction on the bag is maintained for four to five hours by fixation of the catheter tube to the inner side of the thigh or a Hamer cradle Release of traction and emptying of the bag may be followed by considerable bleeding and necessitate refilling and traction The

bag is left in place for five days and can be utilized if the occasion requires its use

The small rubber tube drain is removed from the space of Retzius at the end of forty eight hours the large bladder tube and Pilcher bag on the fifth day and a urethral catheter, 18 or 20 F, is inserted through the urethra into bladder The placing and adjustment of this catheter is extremely important and if well done will completely



... .. ethral

divert the urine and permit early incisional healing. Suprapubic dry
ne er removal

but it is one of the most difficult, usual guidance

and anatomical recognition of structures involved are permitted at all times postoperative shock and abdominal distention are diminished and dependent drainage is more easily accomplished. Pathologically the small fibrous type and all subvesical enlargements are more suitable for removal by this approach. Many illustrious urologic surgeons

have made important contributions to the technic of perineal prosta-tectomy, and its high degree of development, attained perfection, and popularity is chiefly due to Young and his associates

With the patient in an exaggerated lithotomy position on a Halsted perineal board, a Crowell or Lowsley curved prostatic tractor is passed through the urethra and into bladder. The perineal incision in the form of an inverted U, is made with its arch crossing the midline at a point equally distant from the anterior anal margin and perineo

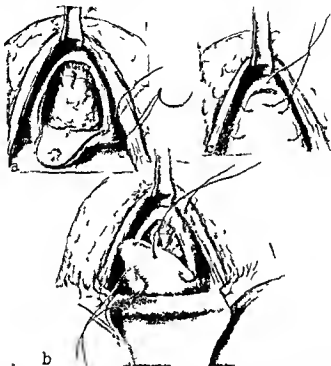


Fig. 467—*a*, Membranous urethra and bladder neck closed over catheter. Sutures through capsule and the bladder musculature obliterate all dead space. *b*, Capsule closed with interrupted sutures. *c*, Completion of closure. (Elmer Belt.)

scrotal junction, and its sides extending downward and slightly out ward to each tuberosity of the ischium. Skin, fat and fascia are in cised until the muscle of bulb is exposed. Great care must be exer cised at this point in freeing the bulb, exposing the transverse perineal muscles and in separating the rectourethralis muscle from the posterior part of the bulb.

The rectum is now pushed backward and the bulb held forward by Young's special bulb retractor. The levator ani muscles are sep arated in the midline and held apart by lateral retractors. Denonvil

lens fascia is pushed backward and the apex and posterior surface of the prostate is presented. The rectum is now held away from the prostate and the levator ani muscles are held apart by Young's broad acute angle retractor. Traction on the tractor is applied and downward and backward pressure aids in bringing the posterior surface of the prostate into better view.

An inverted U incision after the technic of Belt is made through the posterior sheath or capsule of the prostate with the tip of the arch $\frac{1}{2}$ inch posterior to the apex of the gland. This flap of prostatic capsule with the verumontanum and ejaculatory ducts is turned downward and backward, the urethra cut across at the site of the line of cleavage between the apex of the hypertrophied gland and its outer capsule. The curved prostatic tractor is now withdrawn and a straight prostatic tractor inserted. The hypertrophied prostate gland is enucleated by digital manipulation, metal lobe enucleator, curved blunt scissors and prostatic lobe forceps, care being taken not to injure the circular muscle fibers at the vesical neck.

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anteriorly and one each laterally are placed through the edges of the bladder mucous membrane by means of a Crumie needle holder. The anterior set of sutures is now brought out high up through the apex of the prostatic capsule and the two lateral sets are brought through the capsule on either side of the inverted U shaped incision. The catheter is now placed in proper position in the bladder and the mattress sutures tied.

The U shaped flap of prostatic capsule is sutured in position by interrupted sutures, a small rubber drainage tube placed in position, levator ani muscles approximated and the incision closed. Most important now is the fixation of the urethral catheter and maintenance of urethral catheter drainage. The catheter is removed on the twelfth to fourteenth postoperative day, incision heals promptly and the patient has a postoperative hospitalization of about twenty one days.

Transurethral Prostatic Resection—Transurethral prostatic resection is the most outstanding contribution to present day urology and although not new in thought it has been made practicable through the development of high frequency cutting and coagulating instruments and the introduction of the removal of vesical neck obstructions. Wishard, Jones and others have developed ingenious but ineffective instruments for their removal.

McCarthy resectoscope of our present day Two types are in use and are represented by cold punches of the Young Braasch Bumpus tubular instruments, which utilize the cutting mechanism of an inner circular tube which incises prostatic tissue engaged in a fenestrum in the outer sheath, and the resectors with various modifications as developed by McCarthy, Nesbit and Kirwin which utilize the principle

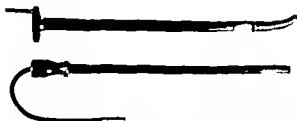


Fig 468—Author's median bar excisor which is constructed and insulated to carry cutting current



Fig 469—McCarthy resectoscope in position for transurethral prostatic resection. (Stirling)



Fig 470—Loop of McCarthy electrode (1) in position (2) at start of cut (3) after completion of procedure (Stirling)

of the wire loop electrode and cutting current and the coagulating current for the control of bleeding The addition by McCarthy of the foroblique telescope permits complete vision and greatly aids the operator in visualizing the area to be resected

Transurethral resection in the hands of the experienced and in carefully selected cases has proved to be a procedure of great usefulness

and of tremendous value. It is still a procedure which requires a great deal of patience, cystoscopic experience, skill and judgment. No one should attempt transurethral prostatic resection who is not a competent urologic surgeon and able to handle the many complications that might arise.

The postoperative care also calls for personnel, competent nursing, patency of the urethral catheter and close observation for hemorrhage, shock and infection. The bar and median lobe type of cases respond readily and there is a considerable economic saving for these patients, but those with large lateral and median lobe enlargements may require two or more resections and finally have to undergo prostatectomy. A classification of cases suitable for transurethral resection includes all the subvesical types of prostatic hypertrophy, fibrotic and glandular median bars, contractions of the vesical neck following prostatectomy, and malignancy of the prostate gland with obstruction.

CARCINOMA OF THE PROSTATE GLAND

Carcinoma of the prostate gland, because of its insidious onset and early symptoms simulating those of benign prostatic hypertrophy with resulting neglect and eventually inoperability, presents for the urologist a problem of great magnitude. Early detection and diagnosis before extensive involvement of the prostate gland has occurred is most essential for instituting the accepted curative procedure of total perineal prostatectomy. Much too frequently, however, does the patient appear with the clinical picture of nocturia and frequency, which has been well tolerated for some time and only increasing difficulty in voiding or pain in the lumbar and sacral areas and radiating down one or both thighs cause him to seek medical aid with the discovery of the extreme hopelessness of the whole situation.

The high incidence of carcinoma of the prostate gland has been noted and emphasized by practically every essayist, particularly since

years of age, dying from various causes and in 28 per cent of males between the ages of 71 and 75. Moore found carcinoma in 63 cases

was limited to one anatomical lobe of the prostate gland. No case was observed in an individual below the 44th year of age and the age

CANCER OF PROSTATE

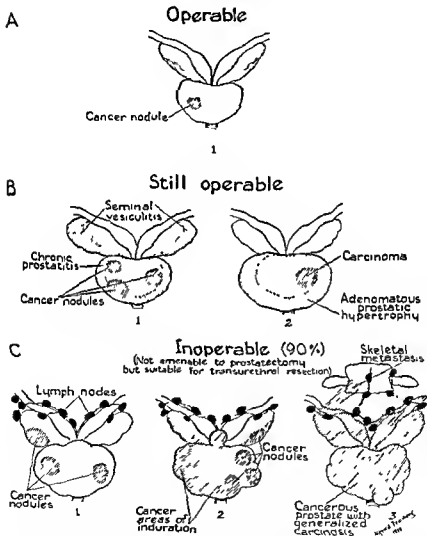


Fig 471—Operable and Inoperable stages of prostatic carcinoma (Robert Gutierrez, Am J. Surg, Vol 48)

incidence steadily advanced until 29 per cent of autopsy cases in the ninth decade showed the lesion.

Symptomatology.—There are no outstanding definite or characteristic symptoms of early carcinoma of the prostate gland. The commonly presented symptoms of nocturia, frequency and difficulty in voiding are those of the typical case of benign prostatic hypertrophy, however, 95 per cent of these cases of carcinoma show such marked involvement, hard, nodular and "frozen" glands, that the patients are unfit subjects for total prostatoseminal vesiculectomy and palliative measures for relief of symptoms can only be undertaken. The finding of an indurated area in the prostate by rectal examination should be viewed with great concern and be sufficient evidence to require further investigation to differentiate it definitely from prostatic calculi or luetic, tuberculous or the common inflammatory conditions of the prostate gland or seminal vesicles.

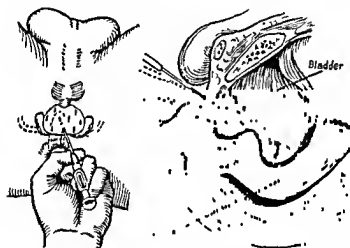


Fig 472—Introduction of radons A, Perineal radon implanter for implanting radons into prostate at site of carcinoma B, Radons implanted into prostate

Diagnosis.—The most readily available and positively diagnostic informative procedure is the correct interpretation of any abnormality in the morphology of the prostate gland discovered by rectal examination. Cysto-urethroscopy, in the early case, gives only the picture seen in benign prostatic hypertrophy. Biopsy, by perineal exposure and excision, aspiration, punch or needle in a high percentage of cases gives satisfactory results. X-ray films are most valuable in revealing metastases which, in carcinoma of the prostate, occur with relatively high frequency in the osseous system. An elevated acid phosphatase content of the blood serum is also diagnostic of bone metastases.

Palliative Measures.—Palliative measures are applicable in the great majority of cases, the primary consideration being the correction

of the vesical outlet obstruction the residual urine and dysuria. This may be accomplished where large lateral lobe hypertrophy is present by suprapubic removal of the lateral lobes punch removal of the obstructive bar and implantation of radon. Transurethral resection followed by perineal radon implantation is applicable to median bar obstruction. Elimination of androgenic hormonal stimulation is accomplished by bilateral orchiectomy or irradiation of the testicles and neutralization of androgenic substance by administration of estrogens. The most satisfactory and best results have been obtained in those cases in which from the cytologic appearance the tumors were classi-

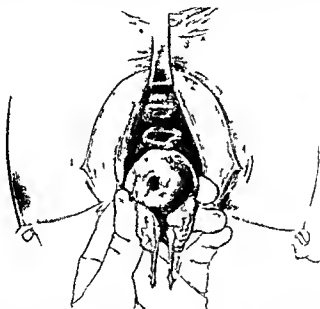


Fig 473—Apex of prostate severed leaving a cuff of capsule attached to membranous urethra. Prostate and seminal vesicles completely freed from attachment to bladder (Elmer Belt)

fied as adenocarcinoma or differentiated carcinoma. Munger from a series of cases concludes that regional and testicular irradiation, transurethral resection and estrogen therapy gave the most effective stabilizing results in carcinoma of the prostate. Barringer reports the results of radiation therapy at Memorial Hospital. Three hundred and fifty-two cases of carcinoma of the prostate gland were treated by radon needles or seeds perineally or suprapubically in the period 1922–1936 with twenty-one or 6 per cent of the patients free of carcinoma for periods between five and nineteen years.

Palliative accomplishments include in the majority of cases a remarkable clinical improvement in dysuria, gain in weight, relief from

pain, improved blood picture, slowing of sedimentation rate, and a gradual approach to normal in the serum acid phosphatase estimation. Improvement in the skeletal metastases is seen in roentgenograms and the gland itself not only shrinks in size and hardness but loses its dense nodularity, frozen fixation and indefinite outline.

Radical Perineal Prostatectomy as a Cure for Cancer of the Prostate Gland.—In 1904, Hugh Young, impressed with the high percentage of cures obtained by Halsted's radical operation for carcinoma of the breast, conceived the idea of performing in selected cases an equally extensive surgical operation through the perineum for radical

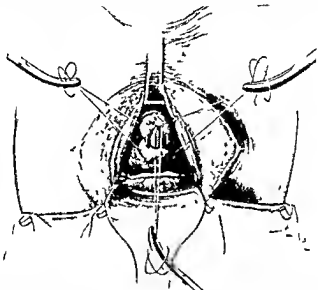


Fig. 474—Introduction of sutures approximating bladder neck to prostatic capsule left attached to membranous urethra. Urethral catheter is placed through urethra into bladder for drainage (Elmer Belt)

cure of cancer of the prostate gland. His radical operative procedure removes all in one piece the prostate gland, its capsule, the fascia of Denonvilliers, seminal vesicles and half of the vesical trigone. The bladder is then anastomosed to the membranous urethra. Belt has

with the history of thirty-eight patients who were observed five to twenty-seven years and who presented no evidence of recurrence or metastasis. Other notable contributions have been George Gilbert

Smith's presentation of seventy one radical operations with twenty one patients living five years or more since operation and twenty whom he examined one to twelve years after operation free from evidence of recurrence and Elmer Belts fifty patients with no evidence of recurrence in twenty nine

PROSTATIC CALCULI

The etiology of prostatic calculi has not been definitely determined and the various expressions of opinion inadequately explain it. The prostatitis which frequently follows gonococcic urethritis has been advanced as an important etiologic factor however prostatic calculi have been found in patients who have never had such an infection. Non specific infection of the tubules and acini of the prostate causing a precipitation of certain salts from the urine oxalates phosphates and carbonates of lime potassium and magnesium and their deposition around a nucleus of inflammatory products has been logically held as a causative factor. Joly states that prostatic calculi are essentially a pathologic condition of adult life and are distinctly uncommon below the age of forty. In most of the cases the calculi are multiple and in a survey of 304 cases only twenty eight patients were reported as having a single calculus.

Symptoms—Oftentimes prostatic calculi cause no symptoms and are discovered in routine x ray study of the gastrointestinal tract and in excretory urographic visualization of kidneys and ureters. Prostatic calculi are also frequently discovered in the routine x ray examination of patients with prostatic hypertrophy or chronic prostatitis their symptoms if any having been completely masked by those of the associated pathological entities.

Diagnosis—In a few cases rectal examination will reveal a hard or indurated area and elicit crepitation particularly when several calculi are in close proximity. The positive diagnosis is made by the x ray study which also reveals number size and location in respect to median or lateral lobe involvement.

Treatment—Prostatic calculi that are accidentally discovered and are not producing symptoms or complicating the treatment and recovery of the patient with chronic prostatitis do not call for surgical intervention. If associated with prostatic hypertrophy prostatic calculi are removed in the routine removal of the prostate. They are often found in the line of cleavage by the enucleating finger or by the metal prostatic lobe enucleator and can be as readily removed by supra pubic prostatectomy as by the perineal route. Calculi in a median bar or lobe have been easily removed by transurethral resection.

Prostatic calculi associated with infection of the prostate gland greatly complicates the proper treatment of the latter and frequency burning and pain on urination with difficulty in voiding are definite

pain, improved blood picture, slowing of sedimentation rate, and a gradual approach to normal in the serum acid phosphatase estimation. Improvement in the skeletal metastases is seen in roentgenograms and the gland itself not only shrinks in size and hardness but loses its dense nodularity, frozen fixation and indistinct outline.

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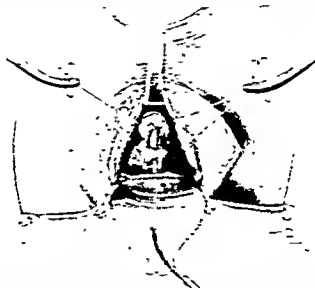


Fig. 414.—Introduction of suture approximating bladder neck to prostate capsule left attached to membranous urethra. Urethral catheter is placed through urethra into bladder for drainage. (Hinch Sel.)

cure of cancer of the prostate gland. His radical operative procedure removes all in one piece the prostate gland, its capsule, the bases of Denovilliers, seminal vesicles and half of the vesical trigone. The bladder is then anastomosed to the membranous urethra. Sel has modified this procedure in those cases in which the prostatic capsule at the apex is uninvolved by leaving a portion of this capsule to which the bladder is anastomosed.

In 1935 Young reported 134 cases subjected to his radical operation with the history of thirty-eight patients who were observed five to twenty-seven years and who presented no evidence of recurrence or metastasis. Other notable contributions have been George Gilbert

Smith's presentation of seventy one radical operations with twenty-one patients living five years or more since operation and twenty whom he examined one to twelve years after operation, free from evidence of recurrence, and Elmer Belt's fifty patients with no evidence of recurrence in twenty nine

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Prostatic calculi associated with infection of the prostate gland greatly complicates the proper treatment of the latter and frequency, burning and pain on urination with difficulty in voiding are definite



Fig 475 -Shows large laminated calculus in bladder and multiple prostatic calculi.



Fig 476 -Illustration shows 105 prostatic calculi. Prostate showed rather marked hyperplasia. 8 ounces of residual urine. Prostate and calculi removed by suprapubic prostatolithotomy procedure.

indications for their removal as well as the removal of any associated hypertrophy—adenomatous, cystic or fibrous Prostatolithotomy by the perineal route is the preferable surgical procedure

An unusual but extremely interesting case of multiple prostatic calculi developed in a young adult who had lost both of his hands as a result of extensive electric burns Shortly after recovering from the amputations he developed retention of urine and his case was diagnosed as paralysis of the bladder He was catheterized several times a day by his faithful wife over a period of eight years and when he was finally referred to us x ray studies showed a large oblong vesical calculus 2 inches in diameter and multiple prostatic calculi (Fig 19) Suprapubic cystolithotomy and prostatolithotomy enabled him to void normally and completely empty his bladder

PROSTATIC ABSCESS

Prostatic abscess, which formerly was occasionally found as a complication of gonococcic prostatitis, is now rarely encountered due to the effective results obtained by the use of the sulfa preparations and penicillin Abscess of the prostate may occur as a complication of some of the acute infectious diseases, such as typhoid and paratyphoid fevers and influenza It has also followed infections such as carbuncle, furuncle, osteomyelitis and tonsillitis On occasion it has been found associated with hypertrophy of the prostate gland and its causation is possibly due to instrumentation

Symptoms.—Chills and fever are not uncommon but often there is a general feeling of malaise which has simulated typhoid fever Pain and suprapubic discomfort is present, particularly in those cases with difficulty in urination and with partial retention of urine Complete retention of urine is associated with marked suprapubic discomfort, which is usually relieved by catheterization In twenty patients with suspected abscess of the prostate gland, in each instance when acute retention of urine developed, prostatotomy evacuated pus from a well defined abscess Rectal examination reveals a definitely circumscribed enlargement of the prostate, with marked tenderness and, in well developed and advanced cases, fluctuation has been elicited

Treatment.—The treatment of abscess of the prostate gland is by incision and drainage through a perineal approach The opposite lobe should be carefully examined and if involved it should also be incised and drained A follow up examination is essential to determine the presence of persisting prostatitis, which should be properly treated if present

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THE TREATMENT OF UNDESCENDED TESTICLE

STIRLING W. MOORHEAD, M.D.*

Two distinct conditions are included in the term "undescended testicle." In the first and more common the gland has halted somewhere along the normal path of descent, has failed to progress to the normal scrotal position. This is known as *cryptorchism*. In the second the testicle has migrated from the normal pathway and has become lodged in an abnormal location. This may be somewhere within the abdomen, in the contralateral scrotal pouch, within the abdominal wall, either just in front of the peritoneum or superficial to the aponeurosis of the external oblique (a common abnormality), beneath the skin of the penis, in Scarpa's triangle, or in the perineum. The congenital lodgment of a testis in any of these locations is termed *ectopy*.

Formerly the differentiation of these conditions was of no therapeutic importance, for we had but one form of treatment available—placement of the testicle in the scrotum by means of surgery. Now we have in addition the administration of hormonal therapy, which is effective in some cases of cryptorchism but never in ectopy, so it is important to make a differential diagnosis whenever possible. When abdominal retention is present the diagnosis cannot be made, nor is it possible in the properitoneal interstitial inguinal type. A correct diagnosis should be made in cases where the interstitial inguinal testis lies on the external oblique fascia, this condition should be suspected when the testis appears fixed, when it cannot be easily pushed up the inguinal canal toward the abdomen. In all other ectopic locations the diagnosis is self evident.

While this discourse is primarily concerned with the therapy of testicular nondescent rather than with the subject in general, only with knowledge of the general subject can a rational plan of treatment be formulated. I shall present this as briefly as possible.

Normally the testicles are in the scrotum at birth, this is the condition in about 86 per cent of cases. Of the remaining 14 per cent the majority descend during boyhood, usually during the first year. The next most frequent period of descent is between the twelfth and fifteenth years. Persistence of the abnormality into adult life has a frequency of about 1/500.

The mechanism of descent is unknown, but undoubtedly gonadotropic hormonal action is a potent factor. To what extent it acts

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through the gubernaculum testis, and to what extent by other means remains undetermined.

Prior to puberty retained and normally placed testes are of approximately the same size, there is little growth during this period. However, according to Cooper who made a careful comparison of the histology of undescended testes removed at operation and scrotal testes removed at autopsy, changes are recognizable as early as 2½ years and become more marked as puberty nears. The changes are less marked in low inguinal glands than in those halted high in the canal. After puberty there is a rapid development of scrotal glands while undescended specimens fail to mature.

Spermatogenesis is not to be expected in the undescended testis and has often been stated not to occur. Yet Rea quotes cases from the literature and from his own practice in which live spermatozoa were found and in which impregnation had allegedly been achieved. The comparatively low temperature in the scrotum is an important factor in normal spermatogenesis.

Improved development and the production of normal spermatozoa is to be expected when the testicle has been placed in the scrotum by artificial means, but the degree of fertility cannot be forecast, as it probably depends on several factors e.g. the health of the transplanted gland, the age at which transplantation is effected, the damage sustained at the time of transplantation, the position attained in the scrotum, and the permanence of that position (a low position

the site
tion has

been observed in transplanted glands we lack proof the operation reduces the frequency of malignant change.

Torsion is probably of more frequent occurrence and is certainly a more serious complication in the undescended than in the normally placed organ.

Infection of a retained testicle or epididymis is likewise a serious matter.

Severe psychological disturbances among cryptorchids have been described.

HORMONAL THERAPY

When cryptorchism exists there is always the possibility that descent can be effected by hormonal therapy so this method of treatment should be given a trial when this condition can be definitely determined to be present. Glands in the lower part of the canal are more apt to be successfully treated than those which have halted at a higher level. The treatment should also be used when physical examination is negative when no testicle can be felt because it may be entirely successful or may cause partial descent so that at operation

the testis can be found, or by increasing the size of the testicle and the structures of the cord may render the operation easier. After orchiopexy hormonal therapy, 200 to 500 units daily, has been advocated by Abrahamson and others to stimulate further development.

The age at which this treatment should be instituted is a moot question. Some would postpone till puberty or thereafter, to permit descent uninfluenced by extrinsic factors, if it will occur, and to give the treatment at the time success is most probable. Also they wish to avoid enlargement of the genitalia, growth of pubic hair and psychological disturbances at an early age. But certainty of success is not attained by this plan, and grave danger of irreparable damage to the testicle is incurred. The disadvantages of such prolonged delay appear paramount.

The middle ground, instituting treatment at the seventh, eighth or ninth year, has more to recommend it, particularly in low inguinal cases, as these testicles suffer less damage from their abnormal position than those which have halted higher in their course. For such cases this plan should be followed.

To a third group institution of treatment during the third or fourth year seems important to forestall degenerative changes. I can see no objection to this if the dosage is kept very low. Genital enlargement should be avoided, though it may be expected to disappear rapidly when injections are stopped.

One of the numerous preparations of chorionic gonadotropin derived from the urine of pregnant women, the so called anterior pituitary-like hormone, is usually chosen for the treatment of these cases. Testosterone may be more effective, but is apt to cause testicular damage. The follicle stimulating hormone derived from the serum of pregnant mares has also been used but has proved less effective, and in high doses it may cause premature closure of the epiphyses and inhibition of pituitary activity with subsequent damage to the testicle, particularly its seminiferous tubules (Bishop, quoting Thompson and Heckle).

The size and frequency of dosage of the chorionic gonadotropin has not been standardized, nor is there general agreement as to how long treatment should be given in the event of nonsuccess. I have had excellent results with 100 units, and in younger boys this dose should not be exceeded. In older boys 500 units twice a week is probably most often used, much higher doses have been employed. I am in favor of starting in the third or fourth year with doses of 50 or 100 units twice a week for a maximum of 10 doses, and repeating the course in a year if unsuccessful. Older children may be given larger doses. Because of the extreme difficulty of operation and the unlikelihood of a good result when there is abdominal retention, the risk of overtreatment should be assumed in such cases especially when bilateral.

OPERATIVE TREATMENT

Operative treatment is mandatory in cases of ectopy, and in cryptorchism when the testicle is palpable but cannot be made to enter the scrotum by a reasonable amount of hormonal treatment. Testes which cannot be palpated present a difficult problem, particularly when bilateral. Their finding may be easy, difficult or impossible, and when found transplantation may be either difficult or impossible. At operation there may be a strong temptation to remove rather than transplant, to prevent the development of a neoplasm. But androgenic potentialities must be considered, and also the wishes of the patient or his parents, so a clear understanding should be had prior to operation.

As indicated in the preceding section, hormonal therapy should usually precede operative treatment. Orchiopexy should rarely be done before the sixth year, but if, after what ordinarily is adequate treatment, descent has not been accomplished by that time operation should be considered, it should never be postponed till after the tenth year.

To be considered a successful operation the testicle must have been placed in the bottom of the scrotum and must remain there permanently, too often at followup examination the testicle is found to be in the upper part of the scrotum or even to lie on the pubis where the relatively high temperature is prejudicial to full development, and where it is exposed to trauma. Usually more or less difficulty is experienced in obtaining sufficient length of cord to place the testicle in the scrotum without tension; some form of fixation in the desired position is always necessary; the number of suggestions for such fixation testifying to the difficulties experienced here also.

inguinal ring. It should be freed from the surrounding tissues and the gubernaculum divided and grasped with forceps. Drawing the testicle

internal ring to cure the potential hernia) the cremaster muscle, and all connective tissue so that the vas deferens and the vessels and nerves of the cord may run a straight course. (In freeing the funicular process from the cord the procedure suggested by Bevan injecting saline solution beneath it so that it is floated from the subjacent tissues materially aids the dissection.) Even when thus freed the cord will usually be too short, but additional length may be obtained by passing the finger behind the peritoneum along the spermatic vessels and freeing them from the surrounding tissues well up to the kidney.

Almost invariably it is the spermatic vessels, not the vas and its vessels, that are short. To gain additional length in very difficult cases Bevan sanctioned division of the spermatic vessels, but it is a mistake to think that he approved the practice and considered it innocuous, for in 1929, thirty years after his first article appeared, he wrote that he had not divided these vessels for four or five years, whereas in his early work he had done so in 10 per cent of his cases. Though the division may not cause gangrene, certainly for a time at least it must impair nutrition, so should be done only as a last resort. Cabot has suggested and practised a two stage reduction in difficult cases, finding that at the second operation the testicle could be lowered to a satisfactory position.

In cases of bilateral nondescent it is rarely permissible to do a bilateral operation, the scrotum is too small to accommodate both testes during the period of postoperative swelling. Preferably the tunica vaginalis is preserved as it is reasonable to assume the testis will develop more normally when this is done. It is removed as a matter of routine in the Torek operation.

Thus far the operative treatment of undescended testicle may be said to be well standardized. So far as I know no one disputes the general principles that the operation should be performed with the utmost gentleness, that an adequately long spermatic cord should be obtained, i.e., sufficiently long to permit the testicle's being placed in the lower part of the scrotum, that its blood supply should be unimpaired, and that having been properly placed it should not be permitted to retract and assume a relatively high position.

Methods of Fixing the Testis in the Scrotum.—When one comes to consider the methods of fixation, one finds a low scrotal position, with the testis resting on the scrotal skin, is usually employed, though all methods are not equally successful.

Bevan's method was simply to suture the tissues about the cord as it entered the scrotum, he expressed disapproval of external methods of fixation. It is difficult to see how Bevan's method can be relied upon to result in anything better than a high scrotal position, even when a greater than average length of spermatic cord has been obtained. Its simplicity and the fact that it does not necessitate additional skin incisions or traction sutures are the only points in its favor.

The numerous methods proposed to hold the testis in the desired scrotal position till it can be expected to stay there of its own accord are of three types

- A Those in which a suture which has been passed through fascia adjacent to the testis is brought out through the bottom of the scrotum to be attached to some anchoring object, usually the skin of the thigh
- B Those in which the testicle is passed through the scrotal septum
- C Those in which the testicle is fastened temporarily to the fascia lata of the thigh

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The operation is done through the incision customarily used for the repair of inguinal hernia. After the aponeurosis of the external oblique has been divided the testicle is usually easily found at or below the

all connective tissue, so that the vas deferens and the vessels and nerves of the cord may run a straight course. (In freeing the funicular process from the cord the procedure suggested by Bevan injecting saline solution beneath it so that it is floated from the subjacent tissues materially aids the dissection.) Even when thus freed the cord will usually be too short, but additional length may be obtained by passing the finger behind the peritoneum along the spermatic vessels and freeing them from the surrounding tissues well up to the kidney

is made in this prominent area and a finger introduced to open a space for the accommodation of the testis. Then once more trans-scrotal pressure is made, so that the septum appears in the scrotal wound. This fascia is incised sufficiently to enable the testis to be drawn through the opening. The cord is then drawn through the lower b rough

it on a strip of rubber dam looped above the gland. A single suture in the septum prevents retraction. Bleeding is controlled and the scrotal wound closed. The inguinal wound is closed without transplantation of the cord.

The method appeals because at the conclusion of the operation operative work has been completed, and because there is no suture material leading down to the testicle, with its inherent threat of infection. (A patient of mine lost a testicle in this way after an operation in which catgut was used for the fixation suture, similar trouble has not followed the use of silk in my experience.) The chief objection to the operation is that the resulting conformation of the scrotum and its contents may not appear normal, too often one testicle is above or behind the other.

Type "C" Retentive Methods—In the so called Keetley Torek operation the testicle is temporarily fastened to the fascia lata of the thigh. Corresponding incisions are made in the lower part of the scrotum and inner surface of the thigh, the testicle is passed through the incisions and fastened to the deep fascia, and the scrotal and femoral skin is sewed about the cord. After three to six months, at a second operation the testicle is freed and the scrotal and femoral wounds are sutured separately. The procedure has the advantage of secure, prolonged anchorage, so that growth may take place. Keetley stated that he never had failed to bring down even an abdominal testis though he had sometimes had to flex the thigh for the purpose. A higher percentage of successful results has been achieved by this than by the "A" method, and the anatomical results are better than by the "B" method.

In doing the operation the upper line of sutures between the scrotum and thigh should be inserted before the testicle is attached. The actual anchoring of the testicle has been done in many different ways a few of which will be briefly described.

Keetley sutured the gubernaculum testis to the fascia lata. He stated that most of his cases resulted in a high scrotal position.

Torek removed the tunica vaginalis and sutured the testis to the fascia lata with three to five sutures of chromic catgut.

Foster, in order to avoid possible damage from sutures inserted into the testis incised the fascia lata and buried the gland beneath it.

Mimpriss also avoided placing sutures in the tunica albuginea having observed deleterious effects in experimental work. He effected

These various techniques, all of which have much to recommend them will be described and discussed

Type "A" Retentive Methods—After adequate length of cord has been obtained a bed for the testicle is prepared by forcing first one, then two fingers down to the very bottom of the scrotum and separating them widely so as to tear the connective tissue content. Recently Vermooten has contributed a valuable suggestion, namely, to "divide the remaining elastic fibers with a knife." To do this he grasps the most dependent portion of the scrotum where the bed just described has been prepared, with a sponge stick and pushing upwards invaginates the scrotum into the wound. Then he divides all connective tissue at the base of the scrotum as it lies in the wound supported by the sponge stick and wipes it to the sides with gauze, so that only skin remains. He contends that by completely severing, not simply stretching, this elastic connective tissue he purposefully accomplishes what Torek and others who suture the testicle to the fascia lata accomplish incidentally, the elimination of tissue which would tend to elevate the gland.

To keep the testicle in the place thus prepared for it until adhesions shall have formed a suture (preferably nonabsorbable because less irritating than catgut) is now passed through the gubernaculum, the tunica vaginalis, or other sufficiently strong tissue, to act as a tractor. Both ends of the suture are to be passed through the bottom of

— that the testicle is held in
um at the desired point a

the suture is grasped with
two Kelly clamps one so low that it guards the point the other half
an inch higher up. The needle can then be guided with the finger to
the bottom of the scrotum and after the lower clamp has been re-
leased, pushed through the skin drawing through the anchoring
suture, which in turn draws the testicle into the scrotum. The suture
may be passed through the skin of the adjacent thigh (a practical and
convenient method), may be tied over a wire frame, or may be at-
tached to either of the thighs through the medium of a rubber band,
so that elastic traction is established. Vermooten and others prefer
to fasten the band to the opposite thigh claiming a straighter pull
— at a point lower than the first one. Fixation or traction is
two sutures the second

This method gives satisfactory results when the cord is of good length inclusion of the suggestion of Vermooten should make it even more valuable in the future than it has been in the past.

Type "B" Retentive Method—In this procedure with which the

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fixation by suturing the tunica vaginalis to the fascia lata. In an effort to protect the circulation of the testicle be refrained from stripping the funicular process from the cord after dividing and ligating it at the internal ring

Abrahamson turned up a strip of fascia lata from 1 to 3 inches long, brought it through the scrotofemoral anastomosis and sutured to it the gubernaculum or gubernaculum and testis

Freeing the testicle at the second stage of a Torek operation, or after Foster's modification of this procedure requires careful dissection whereas after one of the other modifications it is a very simple matter. In cases of bilateral nondescent this operation is usually performed in three stages as only on very rare occasions is the scrotum large enough to be attached to both thighs at the same time

SUMMARY

It is important that the testicles be in the scrotum before puberty. In cases of cryptorchism hormonal therapy may be effective so it should be tried before advising an operation. An irreconcilable difference of opinion exists as to the relative importance of early descent, and therefore as to the age at which treatment should be initiated. This difference results from lack of data as to the spermatogenic potency of testes descending at various ages either naturally or as a result of the administration of hormones or through orchiopexy. Comparative series of cases of bilateral retention with data as to spermatogenesis grouped according to the age at which descent occurred and as to means whereby descent was attained, are needed to settle the question. Such series are difficult to accumulate owing to the small number seen by one individual and the time which must elapse between the first observation of the patient and maturity but until we can compare the spermatogenic potency of testicles which have descended in the first five years of boyhood with that of those which have reached the scrotum in later years we shall have only the relative size of transplanted testes plus histological studies (Cooper) plus thoughtful observation (Mumpriss) to guide us. Urological societies, geneticists, sterility clinics and the like might cooperate for the assembly of such information. It is my opinion that relatively early descent is important.

Certainly we should strive to avoid injury by too vigorous treatment, whether by hormones or surgery. Too large doses of gonadotropin should not be given especially at an early age and when we operate injury should not be done to the testis or its blood supply by too vigorous efforts at reduction.

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TRANSVAGINAL HIGH VOLTAGE THERAPY FOR THE TREATMENT OF CARCINOMA OF THE CERVIX

CHARLES A. BEHNEY, M.D., F.A.C.S.*

PRACTICALLY every physical agent soon after its discovery, has been used in an attempt to destroy carcinoma. This was also true in the case of the introduction of the roentgen rays. The first x rays available were of such long wave lengths that a depth dose favorably affecting carcinoma of the cervix could not be obtained. It was not long however, until therapists attempted to treat this disease directly by exposing the lesion on the cervix with various types of specula and moving the x ray tube close to the vulva. This technic was abandoned to be revived after rays of shorter wave lengths and greater depth dosage became available. A technic for this intracavitary treatment of carcinoma of the cervix was developed and presented by Merritt of Washington. His work so impressed us at Philadelphia General Hospital that we decided to adopt it in certain selected cases of the most advanced stages of the disease.

The results we obtained in Stage IV (Schmitt's classification) were so favorable that we have utilized it in many Stage III cases and in few instances in Stages I and II. In some of our earlier cases in Stages I, II and III, we employed 2500 to 3000 air roentgens and supplemented this treatment with intravaginal radium applications directly against the portio vaginalis. Later we increased our dosage of the transvaginal or cone therapy to 8000 air roentgens and now utilize it to the exclusion of the vaginal application of radium. We do however

utilizes the ordinary high voltage x ray machine. In our work, 200 K.V. were employed but slightly lower voltages may be found to be advantageous. The cones are chromium plated steel tubes lined with 0.5 mm. of lead. By means of an adapter they are attached to the conventional x ray tube. The over all length from the tube to the lesion under treatment is 50 cm. The cones vary in diameter from 1.5 to 3.6 cm., to be adaptable to varying sizes of vaginas. The diameter of the cone most frequently employed is 3.3 cm. Cones are available with either straight or beveled distal ends. Either type may be preferable depending upon the position of the cervix and the conformation of the posterior vaginal vault. A hard rubber obturator with a smoothly

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rounded end, attached to a steel shaft, snugly fits the lumen of the cone. This facilitates the introduction of the tube and avoids discomfort to the patient from pinching of the tissues. Recently we have followed Merritt's suggestion of replacing the obturator by an inflated, rubber, prostatic balloon which protrudes from the distal end of the cone, and after introduction is easily removed by deflation. It appears to give more protection to the soft tissues and permits better exposure of the lesion. The adapter is fitted with a periscopic finder. This enables the growth to be visualized after the apparatus has been inserted and attached to the x ray machine.



Fig 477—Table adapted for leg holders and adjustable elevation at the foot end (Meigs and Sturgis *Progressive Gynecology* Grune & Stratton 1947)

We have found a well padded, flat top, wooden kitchen table, 27 inches high, with ordinary stirrups at the foot end, the most satisfactory object on which to place the patient for treatment (Fig 477). An 18 inch leaf is hinged to the foot of the table. By elevating this the pelvis can be raised 6 to 12 inches as required to bring the vaginal outlet in line with the adapter attached to the tube of the x ray machine. Accessories are shown in Figure 478. The patient is placed in the lithotomy position with the buttocks on the edge of the aforementioned lift (Fig 479).

While the labia are separated with one hand, the well lubricated cone, with the inflated balloon in place, is inserted gently into the

vagina The balloon is now deflated and withdrawn, and the distal end of the cone under direct vision is placed directly over the lesion on the cervix Holding the cone in place, the table is moved into the

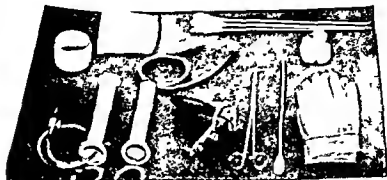


Fig. 478—Upper row, left to right, Lubricant, gauze sponges deflated prosthetic bag applicators and cotton balls Lower row, left to right, Prosthetic bag in steel cone, with attached manometer bulb for inflation, spare cone, speculum uterine dressing forceps, uterine sound and rubber gloves (Meigs and Sturgis, *Progressive Gynecology*, Grune & Stratton 1947)

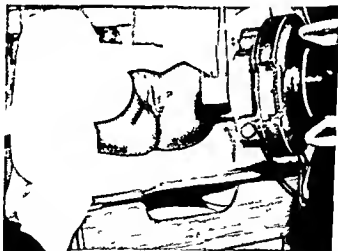


Fig. 479—Patient placed on table and draped. Cone adapter with periscope attached to x ray tube (Meigs and Sturgis, *Progressive Gynecology*, Grune & Stratton, 1947)

position necessary to enable the proximal end of the cone to be attached to the adapter, fastened to the x ray tube (Fig. 480)

A preliminary series of high voltage x ray treatments is given to each

patient The factors consist of two anterior and two posterior ports, with each field 15 to 20 cm in diameter The center of the field of radiation is angled at about 30 degrees and directed toward the center of the body A total of 2000 r, measured in air, or 3000 tissue roentgens are delivered to the tumor Two hundred kilovolts, STD, 50 cm and filters of 0.5 copper plus 1 mm aluminum are used for both the external irradiation and the transvaginal therapy When the external irradiation is well tolerated transvaginal therapy may be given coincidentally If poor tolerance for the external irradiation is shown the transvaginal treatment, consisting of 6000 r in air or 6900 tissue roentgens, is deferred until the course of external irradiation has been

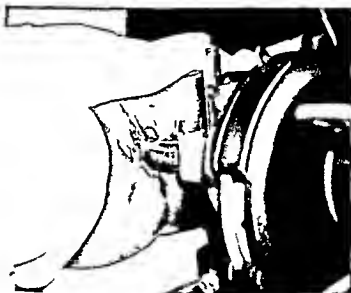


Fig 480—Patient in lithotomy position draped with cone inserted in vagina and attached to adapter which in turn is attached to the x ray tube (Meigs and Sturgis *Progressive Gynecology*, Grune & Stratton 1947)

completed Intracavitary irradiation seldom causes any untoward reaction The transvaginal treatments are given on alternate days, and 500 r are administered through the cone at each treatment A second series of external irradiation treatments similar to the first is given 6 to 8 weeks after completion of the cone therapy

We have been particularly impressed with this method of treating Stage IV cases of carcinoma of the cervix Thirty three patients have been treated in this manner and their average life duration was twice as long as that of the 161 cases who were treated with external high voltage therapy alone Thirty six patients in Stage III showed no apparent difference in the duration of life after treatment when com

pared with Stage III cases that had been treated with external high voltage x ray therapy and radon irradiation

Our experience with the use of transvaginal high voltage x ray irradiation to the portio vaginalis has led us to prefer this method to vaginal irradiation with radium. With cone therapy there is less necrosis of normal tissue and very little distortion follows healing. We believe that it is just as efficient, if not more so, than vaginal therapy with radium. If radical surgery is practiced following irradiation, technical difficulties so often encountered after intensive radium irradiation, because of the dense scar tissue which develops in tissues adjacent to the cervix, are greatly reduced.

CHRONIC LEG ULCERS

SAMUEL LISKER M D *

THE subject of chronic leg ulcers immediately suggests the form due to abnormalities of the peripheral venous circulation but it would be well to remember that there are other causes of leg ulcers, some of which are not rare. Fortunately for the surgeon the varicose ulcer presents so many other characteristics that the etiological diagnosis may be made on single inspection in almost all cases.

A consideration of etiologies other than those associated with varicose veins is beyond the scope of this paper.

DIAGNOSIS

Chronic varicose ulcers are found almost without exception in the lower third of the leg, the largest number on the medial side of the leg above the internal malleolus. Ulcers occurring in the midleg and especially those above this level should be viewed with suspicion. Another rather helpful feature of this disease is the fact that the tissue surrounding the ulcer shows the effect of severe deficiency of the circulation—stasis dermatitis, pigmentation and loss of tissue elasticity. Finally the presence of varicosities in the vicinity of the ulcer or proximal to it completes the clinical picture.

The history of the treatment of varicose veins and ulcers is characterized by periodic discoveries of new methods which were soon found to be inadequate by the standards of that time. No serious attempt was made to study the pathological physiology of this disease and chiefly for this reason no real progress was made. In 1891 the first test based on the reversal of blood due to incompetent valves was described. This was the Trendelenburg test which with some modification is widely used today. The terminology used in this test depending as it does on whether or not a communicating vein is above or below the knee serves no useful purpose and unfortunately has caused confusion in the literature on this subject. Other tests whose purpose it is to determine the patency of the deep venous circulation have been devised. These are based on the Perthes test which by compression of the superficial venous circulation forces the venous blood into the deep circulation. If the patient tolerates the compression and especially if the symptoms are improved during the test the deep

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pared with Stage III cases that had been treated with external high voltage x ray therapy and radon irradiation

Our experience with the use of transvaginal high voltage x ray irradiation to the portio vaginalis has led us to prefer this method to vaginal irradiation with radium. With cone therapy there is less necrosis of normal tissue and very little distortion follows healing. We believe that it is just as efficient, if not more so than vaginal therapy with radium. If radical surgery is practiced following irradiation, technical difficulties so often encountered after intensive radium irradiation, because of the dense scar tissue which develops in tissues adjacent to the cervix, are greatly reduced.

are other incompetent communications the sclerosing solution may or may not obliterate these but it will certainly cause the patient considerable pain for from three to five days postoperatively Sclerosing solutions cannot be considered a substitute for careful examination

The Need for Ligating the Five Branches of the Saphena Magna—There has been some honest difference in opinion as to the necessity for ligating the five branches of the saphena magna before it joins the femoral vein Surgeons have argued that since the major trunk was ligated and cut there was no necessity for ligation of the lesser vessels It has been our experience that one of the causes of failure has been a communication of one of the branches of the sapheno femoral vein with the deep circulation This junction would in effect allow blood to reflux down the saphena magna around the site of ligation These small branch veins when missed may attain great size and indeed may be nearly as large as the saphena magna itself At first glance it may appear that the surgeon who first operated missed the saphena magna It is our feeling at present that each of the branches of the saphena magna should be carefully sought out ligated and cut and careful examination for anomalous veins should be carried out these to be treated in the same manner It is well known that the amount of scarring following a saphenofemoral ligation is such that reoperating for a missed vein is a tedious and time consuming procedure For these reasons it becomes apparent that a saphenofemoral ligation should be carried out under general anesthesia and is not an outpatient procedure Accidental laceration of the femoral vein is an unpleasant experience because of the amount of bleeding and the difficulty in its control It follows then that this procedure is not one for the occasional operator

Method for Detection of Multiple Incompetencies—Since three quarters of our patients had multiple incompetencies it might be well to review the method used for their detection With the patient standing lines indicating the locality of the varicosities are drawn on the skin with a water proof pencil The patient is then placed on his back and the extremity elevated to empty the veins a tourniquet is applied over the fossa ovalis or just below it and the patient is then asked to stand If the varicosities do not fill or fill very slowly under low tension there is a single reflux at the saphenofemoral junction Should the veins refill rapidly on standing the tourniquet is applied at successively lower levels until the varices do not refill Each level at which compression caused a collapse of the varicose veins is marked and finally tourniquets are applied simultaneously at each level suspected of being the site of an incompetent communicating vein If the varices do not fill on standing the position of the tourniquet along the saphena magna or saphena parva indicates an incompetent communicating vein which should be ligated

With a little experience it becomes evident that incompetent com

circulation is considered adequate and surgery should prove beneficial. There is no doubt that the widespread use of these tests together with the development of better injection techniques and sclerosing solutions has speeded up the progress of our knowledge of this disease.

TREATMENT

During the past twenty years considerable progress has been made in the treatment of varicose ulcer. It has gradually become evident that the most important factor in the treatment is the restoration of the normal direction of blood flow in the superficial and communicating venous systems.

Sclerosing Solutions versus Ligation and Excision—No one at present seriously considers the use of sclerosing solutions alone as the treatment for varicose veins, yet this was an accepted method a little more than fifteen years ago. We are at present going through a period of rapid change. There is as yet no universally accepted method of treatment. Some surgeons feel that saphenofemoral ligation with or without the injection of a sclerosing substance in the distal segment of the saphena magna is preferable, still others resect prominent varices in the belief that removal will destroy the incompetent communicating veins causing the varix.

It has been established that with the exception of the simple phlebectasias, varicose veins are in the main due to incompetent venous valves. These valves may be congenitally deficient or absent, or fail to coapt because of dilatation of the segment of vein in which they are located. The valve may be destroyed by inflammatory change as in phlebitis or may fail to function as the result of an incompetent valve proximal to it in the same venous circuit.

Incompetent venous valves may be found in almost any part of each of the three venous systems of the lower extremities. The commonest site of failure is in the valves of the communicating system.

It becomes evident from the foregoing that the only way to correct the venous circulation in the lower extremity is to seek out and ligate those communicating veins which are incompetent. Further, it is clear why any surgical procedure which destroys the incompetent vein will succeed provided that there are no other nonfunctioning valves in the venous system.

About 20 to 25 per cent of our cases had simple saphenofemoral reflux. This figure corresponds well with the percentage of congenital anomalies of the saphenofemoral valve found at postmortem examina-

quent blocking might well be helped by ganglionectomy, and further the presence of an indolent varicose ulcer, together with evident increased sympathetic tone, might well be benefited by this procedure

Local Applications.—The results from applications of freshly drawn or powdered blood to the ulcer, with or without penicillin or sulfonamides, have not been impressive. Occasionally an ulcer would heal rather rapidly only to break down again in a few weeks. When it was possible to correct abnormalities of the peripheral venous circulation surgically the ulcers healed rapidly without the use of any local treatment. Unfortunately, just as true

medical journal is replete with descriptions of various ointments whose virtues are extolled. Experience has shown that practically none of these do more than act as a bacteriostatic and emollient. Some ointments are irritating and may be actually harmful. We have come to rely on simple hydrated lanolin for its emollient effect and on dilute hydrogen peroxide as an antiseptic.

In short, local applications alone are useless. Unless the underlying abnormalities of the venous circulations are corrected the treatment will fail.

Skin Grafting—In chronic ulcer which is surrounded by an area of scarred and inflamed tissue, excision of the ulcer bearing skin followed by skin grafting has been attempted. Patients selected for this procedure had extensive tissue damage and repeated ulcer recurrence of long duration. The procedure was carried out by the maxillofacial surgeons because of their experience with skin grafting. Our series was very small and for this reason no conclusions can be drawn.

Summary of Treatment.—Vancose ulcer patients are admitted to the hospital and are evaluated from a medical standpoint. If edema is present the patient is kept in bed until this has subsided.

The arterial and venous circulations are checked and if there is evidence of refluxing venous valves these are marked. If there is no serious deficiency of the arterial circulation and the symptoms are directly due to the varicose veins and/or ulcer, surgery is carried out

Should there be a varicose ulcer an Unna boot is applied in the operating room and left on for ten to fourteen days. We have had no difficulty with incisions which were under the Unna boot.

ILLUSTRATIVE CASES

Brief reports in two typical cases follow

CASE I—Mrs. I. B. a 47 year old female, treated the stasis de over the internal m saphenofemoral valv

communicating veins occur most frequently just above the knee and just below it, less frequently in the mid thigh and at lower levels of the leg. In fact, incompetent communicating veins may be present almost anywhere in the lower extremities as low down as the malleoli or on the dorsum of the foot. They have been found beneath varicose ulcers which fail to heal after what was considered an adequate surgical procedure. In cases in which the varicosities are of good size one may see small elevations in the varix which seem to be under greater tension than the surrounding vein. If the little finger is gently pushed into this elevation the vein wall may become invaginated through a perforation of the superficial fascia which indicates that this is the site of a blow or incompetent communicating vein. This type of incompetent communicating vein is called visual blow in our clinic. On occasion the mapping out of the venous circulation in cases of multiple blows may become rather irksome but a few extra minutes spent in the examination may make the difference between a single successful procedure and more difficult secondary operations. The presence of thrombosis in the superficial venous circulation may make it difficult to be sure of the site of a blow and secondly more than one communicating vein may be found at operation when only one is suspected. It is therefore advisable to expose the veins well and search for communicating veins with the finger for at least an inch in all directions.

In the management of large varices which become extremely tortuous and for which no definite incompetent communicating vein or veins can be found, resection is the best treatment and results in this type of case are generally good.

Sympathetic Ganglion Block, Lumbar Ganglionectomy—The management of these cases may be much more difficult in the presence of thrombophlebitis. More rarely we have seen patients who had pain far in excess of that to be expected. A similar group of patients with varicose veins who had ulcers and were either unable to walk at all or limped very badly in addition had marked arteriospasm to such a degree that in a few instances the dorsalis pedis artery could not be found. The extremity was cold and sweating was excessive. Because of this picture sympathetic ganglion block was performed usually third lumbar or third and second lumbar if the first block was ineffective or if a prevertebral vein was entered. Without exception the pain disappeared and the patient would remain comfortable for days or even longer. It has been shown that extremely painful varicose ulcers may have a varix beneath them which is the site of acute thrombophlebitis. Other clinics in our vicinity have gone so far as to increase sympathetic tone was been effective in our hands and ganglionectomy. To be sure the ionic block and who requires fre-

TECHNIC OF HERNIA REPAIR

NORMAN S. ROTHSCHILD, M.D.*

In the repair of indirect and direct inguinal hernias, the condition of the structures found in the field of operation is significant. Generally, in the small incomplete inguinal hernia the abdominal ring is small, the tone of the structures is good, the posterior wall of the canal has its normal attachments and no protruding preperitoneal fat is present. In the case of the large indirect and direct hernias, however, the abdominal ring is considerably enlarged and the posterior wall of the canal is absent and will generally admit three fingers. As this anatomical field is exposed, the lower edge of the internal oblique and transversalis muscles and their fascias are seen to be pulled medially. It is this lower part of the canal, Hesselbach's triangle, that all agree is the area to be strengthened and that, if any weakness remains in it after operation, recurrences are likely.

The contributions of Bassini¹ and Halsted have been our standards in hernia repair and only because of the high percentage of recurrences (5 to 7 per cent) have modifications been made. All operative procedures deal with three cardinal principles: (1) clean dissection, with absolute hemostasis, (2) high extirpation of the sac, (3) reconstruction of the posterior wall of the inguinal canal.

Careful avoidance of injury to the iliohypogastric nerve is important, and transposition of the neck of the sac is a valuable procedure. I do not intend to enter into a discussion as to whether muscle will unite firmly with fascia, but this apparently has taken place in our cured cases.

The bane of every surgeon is the recurrence of a hernia. Several factors both in the patients' condition and the surgeon's technic contribute to this. The patient may have a "pot" or a weak muscle.

The bane of every surgeon is the recurrence of a hernia. Several factors both in the patients' condition and the surgeon's technic contribute to this. The patient may have a "pot" or a weak muscle and weak and shredded fascias. The mechanics of the repair may be perfect, but recurrence may take place within six months. Faults in the surgeon's technic are all too frequent, such as the approximation of tissue under undue tension, poor hemostasis, incomplete removal of fatty and areolar tissue on muscle and fascia, and failure to make certain that no intra-abdominal fat is present at the site of ligation of the sac. Infection, unquestionably introduced into the field of operation by the surgeon, accounts for the largest percentage of recurrences.

McVay and Anson² have described and have attempted to popularize

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communicating veins in the right leg along the course of the saphena magna and one in the left. At operation these were found, ligated and cut, and a Unna boot was applied to the right leg. The patient has been followed for one year during which time the stasis dermatitis has disappeared, the site being marked by an area of pigmentation. There has been no recurrence of the ulcer.

CASE II—Mr. G. A. B., a 52 year old druggist, was known to have varicose veins since 1933. In 1937 a right saphenofemoral ligation was done elsewhere with what is reported to have been a good result. In 1940 there was a recurrence

above the internal malleolus which was so painful that the patient was unable to obtain relief except by lying down and elevating the foot. Examination was impossible because of the pain. It became necessary to inject the third right lumbar sympathetic ganglion with procaine. There was immediate relief and the examination was carried out. The original saphenofemoral ligation was considered adequate but there were five incompetent communicating veins between the superficial and deep circulation. These were ligated and cut and an Unna boot was applied to support the ulcer. The ulcers healed, there are no varicosities and the patient is symptom free.

oblique muscle the transversalis muscle and fascia and the conjoined tendon (when present) and an attempt is made to approximate them to Cooper's ligament. If a large abdominal ring is present this is al

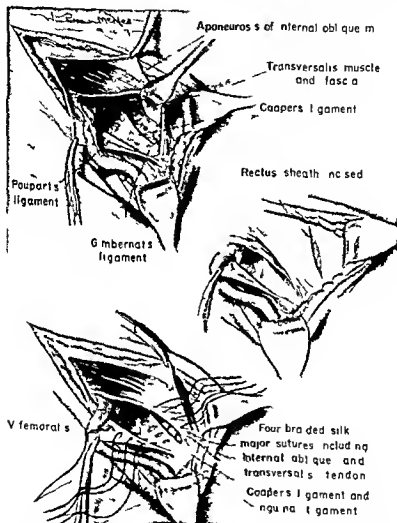


Fig 481—Upper left Exposure of Cooper's ligament. Middle right Incision of rectus sheath to allow for approximation of structures to Cooper's ligament. Lower left The introduction of the major sutures

ways impossible. We now raise the inner flap of the wound and expose the anterior sheath of the rectus which is incised for a distance of 2 to 3 inches down to the pubis. If the structures can be gently

the use of Cooper's ligament as an anchor for suturing of the transversalis fascia and other components to form the posterior wall of the canal. They believe that the inguinal ligament is loosely held in its convex position by the surrounding fascias and that it is easily shelled out of its fascial bed to become merely the free margin of an aponeurosis extending between two points. They have shown that when traction, simulating the pull of the muscle which might be sutured to Poupart's ligament, is applied in a cephalad direction, the ligament is displaced superiorly and may leave the lower inguinal region completely exposed beneath it. Cooper's ligament is a tough ligamentous structure with a firm bony fixation and is therefore admirably adapted for suture. In the operative field it is readily palpated about $\frac{3}{4}$ inch from the inguinal ligament at its lowermost point on the superior pubic ramus, where it forms an elevation covered by fatty tissue. The use of this ligament, however, was described earlier by Stetten⁴ and also by Babcock⁵ in a technic for the repair of femoral hernia. We are not convinced, however, that the mere suturing of the transversalis fascia to Cooper's ligament is a sufficient guarantee against recurrence of the hernia, since in our observation the former is frequently poorly developed.

We now use a modified McVay herniorrhaphy which is as follows. An incision is made from the pubic spine, upwards and outwards, for a distance of at least 4 inches, exposing the aponeurosis of the external oblique, splitting it in the line of its fibers through the fascial ring. Poupart's ligament is next exposed and it and the internal oblique, transversalis muscles and conjoined tendon are cleansed of all tissue

now brought into the wound. If cremasteric muscle fibers are present, they are removed. The sac is identified and stripped from the cord and its vessels by sharp and blunt dissection, the sac is opened and the contents, if any, are reduced. A finger is introduced into the peritoneal cavity in order to ascertain if a direct hernia is present in conjunction with the indirect hernia. One must be sure before applying the ligature around the neck of the sac that no intraperitoneal fat is interposed at this point. The neck is now transfixed with a means gently dissected and pushed toward the midline or posterior surface. Before

this to be necessary. This subject is now placed on the

CONCLUSION

Clean dissection high ligation of the sac absolute hemostasis and the suturing of relaxed structures to an immovable ligament may be the answer to the repair of direct and indirect hernias

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placed in contact with Cooper's ligament, no further undermining or incision of the rectus sheath is necessary. There are numerous small bleeders encountered following the incision and it is imperative to ligate them. Following this procedure it will be found that the muscles and fascia can readily be approximated to Cooper's ligament without tension.

We have been using nonabsorbable suture material, braided silk, for the three or four major sutures and chromic catgut for the remaining sutures. Whatever preference the individual surgeon has for suture material—absorbable or nonabsorbable, catgut, silk, cotton or wire—will have no effect on the end result.

The "major" sutures, which we have referred to above, are now placed in the tissues. The first one, which is the lowest, picks up first, the conjoined tendon (if present) or the lower portion of the internal oblique, the transversalis and the transversalis fascia, passes through the lowest point of Cooper's ligament, then through the periosteum of the spine of the pubis and through Gimbernat's and the inguinal ligaments. The remaining sutures are placed 1 cm apart and pass through the internal oblique, transversalis and transversalis fascia through Cooper's ligament and through the inguinal ligament.

At the operating table we have frequently measured Cooper's ligament between the spine of the pubis and the femoral vein, and find it to be between 2.5 to 3 cm in length. We therefore feel that any suture through Cooper's ligament beyond this point would cause pressure on the femoral vein with subsequent injury to it, producing complications. Further completion sutures containing portions of the internal oblique and transversalis muscles and the inguinal ligament for the formation of the posterior wall of the inguinal canal are made with chromic catgut. These sutures are tied and the aponeurosis of the external oblique is sutured under the cord with fine chromic catgut. The subcutaneous tissue is approximated by interrupted plain catgut sutures and the skin is sutured with plain catgut. A spica muscle bandage is now applied.

Postoperative Care—Patients are placed on house diet twenty-four hours after operation and become ambulant forty-eight hours after operation. If they cannot void they are permitted to stand for this purpose, with assistance, within the first twenty-four hours. We try to avoid catheterization. Sutures are removed on the seventh postoperative day. Patients wear an abdominal support for a period of at least six months.

Harkins and his associates⁶ have reported a series of 131 cases in which the McVay technique was used with but one recurrence at the time of the report. We have used it in seventy cases and as to date have had no recurrences.

CONCLUSION

Clean dissection, high ligation of the sac, absolute hemostasis and the suturing of relaxed structures to an immovable ligament may be the answer to the repair of direct and indirect hernias

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RECENT ADVANCES IN ANESTHESIA

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WE have interpreted the title of this article literally and have regarded "recent" as including only the past few years. During this time a great deal of the literature on anesthesia has been concerned with problems and experiences arising in wartime. These have been omitted from the present discussion. Those anesthesiologists who were not members of the armed forces were able to do little original investigative work during the war. In certain fields there are real advances to report, in other fields including those of inhalation and rectal anesthesia few steps forward have been taken. We have therefore limited the selection of topics severely as indicated below. The development of curare and curare-like drugs is discussed in another paper in this volume, so that no reference will be made here to that major contribution to anesthesia.

SPINAL ANESTHESIA

During the past few years a number of refinements have been made in the field of spinal anesthesia.

1. **Continuous Spinal Anesthesia.**—To replace the German silver malleable needle described by Lemmon¹ a number of authors have recommended introduction of a fine (No. 4 F) ureteral catheter into the subarachnoid space.²⁶ The catheter is threaded through a 16 gauge Huber point needle placed intrathecally; the needle is withdrawn and the catheter remains in place. A blunt hypodermic needle is inserted in the proximal end of the catheter and a Luer Lok syringe filled with anesthetic mixture is attached to the hub of the needle. The advantages of this method of prolonging spinal anesthesia include the fact that the catheter is not displaced from the subarachnoid space as readily as is the needle. Greater mobility of the patient is thus possible. The thick mattress used by most anesthetists with the needle technic can also be eliminated when the catheter is used.

Saklad and co-workers²⁷ have advanced a thin catheter cephalad within the subarachnoid space a distance of 15 to 25 cm. above the lumbar area. A 1:1000 solution of pontocaine is injected. By using this very dilute solution and by injecting through a catheter placed

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opposite the segments to be affected it has been possible to reduce the total dose of spinal anesthetic to a fraction of that ordinarily required. This technic has been termed *intraspinal segmental anesthesia*. The possibility of direct injury to intrathecal nerve roots or to the cord substance itself must always be considered. Whether an indwelling catheter might predispose to the development of arachnoiditis also remains to be seen.

2 Differential Spinal Anesthesia—Sarnoff and Arrowood, using a continuous spinal technic, have been able to block differentially various nerve pathways in the subarachnoid space.^{3, 4} This method of "differential spinal" involves the use of dilute solutions of local anesthetic agents (0.2 per cent procaine). Conduction in sympathetic nerves is abolished and block of various sensory modalities occurs. There is no action on motor nerves. It is possible to have patients retain a sense of position, the sensation of temperature and touch and yet have abolition of pain. The method is a valuable experimental tool. It is being used to study the mechanism of the decrease in blood pressure which occasionally accompanies the administration of spinal anesthesia. The early disappearance of postural reflexes has been demonstrated with this technic, i.e. the knee jerks disappear before or simultaneously with pain perception. Studies of the innervation of the gastrointestinal tract have been made by observing the effect of an increasing level of sympathetic block on balloons placed in various segments of the bowel. Patients with hypertension being evaluated for thoracolumbar sympathectomy can be given differential spinal and the effect on blood pressure determined at various levels of sympathetic block. How well this response will correlate with the results of surgical excision of sympathetic ganglia remains to be seen. In general the method has many uses and deserves future attention.

3 Pressor Drugs—A number of sympathomimetic drugs have been introduced recently. Many of these substances have been injected intramuscularly prior to spinal anesthesia in an attempt to minimize the hypotension which occurs in some patients. A clinical study of the effectiveness of some of these agents has revealed that it is possible to reduce the incidence of a significant decrease in blood pressure to less than 4 per cent of all cases.⁵ The most successful drug in this particular series was methedrine but neosynephrin has also proved successful in other hands. The pressor drugs are being studied from a variety of standpoints. Some are potent central nervous system stimulants and may be useful to combat narcotic poisoning.⁶ Some have much more prolonged periods of action than others. Some cause tachycardia, others bradycardia.⁷ Some increase peripheral resistance primarily, others act chiefly by direct cardiac stimulation. In short the physician has been supplied with a variety of substances from which to choose a drug for the maintenance of blood pressure or for the treatment of hypotension.

In an attempt to prolong the action of a single injection of a spinal anesthetic drug various pressor substances have been added to the solution injected intrathecally.^{7, 8} Ephedrine, epinephrine and neosynephrin have all been found to increase the duration of action of spinal anesthesia and to permit a decrease in the dosage required for a particular procedure. The mechanism of action of such a combination is uncertain. It may be related to local vasoconstriction in much the same way that epinephrine limits the absorption of anesthetic agents following infiltration. On the other hand, the possibility of a direct action of the constrictor substance on nerves has not been eliminated. To date there have been no reports of increased neurological sequelae following the use of such mixtures.

4 Spinal Headache.—Headaches relieved by assumption of the supine position, usually of frontal or occipital distribution and occasionally associated with stiff neck, pain across the shoulders, nausea and vomiting occur after a certain proportion of spinal anesthetics. A wide variety of therapeutic measures have been adopted in the treatment of this annoying complication. The intravenous injection of 100 mg. of the sodium salt of nicotinic acid has recently been advocated for the relief of various types of headache, including those following lumbar puncture. The initial report of such treatment was enthusiastic.⁹ In our hands, however, nicotinic acid has not proved a panacea. It has produced some relief in about 50 per cent of the cases but a dramatic, permanent and complete cure has been the exception rather than the rule. We have had equal success with the intravenous administration of 0.5 gm. of caffeine and sodium benzoate. The cause of such headaches remains obscure and until the mechanism is more clearly defined therapy must of necessity remain empirical. Opinion expressed in many quarters is that the incidence of postspinal anesthesia headache is increasing. The relationship of this increase to the use of early ambulation is an important problem for the future.

5 Therapeutic Uses of Spinal Anesthesia.—In addition to the administration of spinal anesthesia for the treatment of megacolon and peripheral vascular disease of the lower extremities this method of anesthesia has been suggested for the management of pulmonary edema¹⁰ and for the prevention and treatment of thyroid crises.¹¹ The rationale underlying the use of subarachnoid block in pulmonary edema is based on the vascular response which follows interruption of sympathetic constrictor paths to veins. Pooling of blood occurs on the right side of the circulation and venous pressure is reduced as the result of a bloodless phlebotomy. Pulmonary congestion is thus relieved. Confirmatory reports have not appeared in the literature.¹² Knight¹¹ reported that the use of spinal anesthesia in thyroid crisis was effective in the treatment of the hyperthyroidism and in the prevention of the recurrence of the crisis. He reported that the use of spinal anesthesia in the treatment of thyroid crisis was effective in the treatment of the hyperthyroidism and in the prevention of the recurrence of the crisis.

thetize that part of the sympathetic nervous system which innervates the adrenal glands, thereby reducing the secretion of epinephrine

DIAGNOSTIC AND THERAPEUTIC BLOCKS

Interruption of conduction in various parts of the sympathetic and peripheral somatic nervous system by means of local anesthesia is now common practice. Certain trends have become evident and a few new indications for therapy have arisen during the last several years. Local block of the thoracic sympathetic outflow for the pain of angina pectoris is used less frequently. One also hears less of this block for bronchial asthma. Vasospasm and thrombophlebitis con-

... blocked the stellate ganglia with remarkably good results in certain neurologic disorders, including cerebral vasospasm, cerebral thrombosis, postencephalitic parkinsonism. Repeated blocks are necessary. Relief of spasm in cerebral vessels together with an increase in blood supply to the brain are alleged to result from such therapy. Pial vessels have been seen to increase in size as soon as the ipsilateral ganglion has been successfully injected. Interruption of the stellate ganglia has also proved useful in the management of causalgic states in the upper extremities, presumably secondary to relief of spasm and increase in blood flow to the arm and hand.

A new method of producing blockade of autonomic ganglia by means of parenteral injection of the tetraethylammonium ion has been introduced.^{13, 16} Tetraethylammonium bromide (Etmon) is administered as a 10 per cent solution. The intravenous route is more common, the dosage varies from 100 mg to 500 mg. Intramuscular injections are possible in doses based on 20 mg per kilogram. As described by Berry and co-workers¹³ "the intravenous injection produces a metallic taste in the mouth in 15 to 20 seconds on most occasions. Thereafter, the patient notices a cool sensation in the hands and feet which is followed within five minutes by a perceptible increase in skin temperature. There is an incomplete dilation of the pupil with some loss of accommodation. Shortly after the injection (approximately one minute) systolic and diastolic blood pressures

These authors report successful results with tetraethylammonium bromide in the treatment of Raynaud's disease, acrocyanosis, intermit-

tent claudication, acute superficial migratory phlebitis peripheral arteriosclerosis obliterans, causalgia, post traumatic edema, reflex sympathetic dystrophy and thrombophlebitis

INTRAVENOUS MEDICATION

A number of narcotics ordinarily administered by other routes are now being injected intravenously for various therapeutic purposes. These drugs include procaine, alcohol and ether.

Intravenous Procaine.—In 0.1 and 0.2 per cent concentrations procaine hydrochloride has been used to combat allergic reactions and to treat pain. Serum sickness and the urticaria secondary to other allergic responses have been successfully treated.¹⁷ The pain of burns,¹⁸ postoperative pain,¹⁹ the pain and spasm of arthritis,²⁰ and even the pain of childbirth¹ have been alleviated in this manner. Standard practice is to inject by intravenous drip 1 to 2 gm. over a one and one half to three hour period. In obstetrical practice as much as 10 gm. have been given in twelve hours.

The results following procaine intravenously are not completely satisfactory. Relief of urticaria, pruritus, pain and spasm may be only temporary, little more than outlasting the pharmacological action of the drug. Sufficient data are not yet available for a final evaluation but it is doubtful if this method of therapy will find widespread adoption. On the other hand its usefulness in certain cases cannot be denied.

Our knowledge of the pharmacology of procaine has been advanced considerably through observation of patients receiving procaine by the intravenous route. Surgeons and anesthetists have always insisted on frequent aspiration during regional anesthesia. Fatalities were not infrequently attributed to the accidental intravenous injection of local anesthetic agents. Although it is undoubtedly wise to avoid intravascular injection it is apparent that 5 to 10 cc. of a 1 per cent solution of procaine (50 to 100 mg.) can be injected intravenously at a moderate rate without producing much more than dizziness, headache, somnolence and perspiration. Unless the rate of injection be very rapid, the dosage large, or the patient sensitive to the drug, intravenous injection can be regarded as relatively safe. Sudden deaths during infiltration with procaine are probably best classed as "idiosyncrasy," an admission of defeat as far as knowledge of the mechanism involved is concerned, but the best diagnosis available at the present.

Intravenous Alcohol.—Five to 10 per cent alcohol in glucose or

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vides approximately 400 calories. It is our opinion that alcohol is a useful therapeutic agent, particularly in the treatment of the aged. If the fluid is injected too rapidly, inebriation results. This may be accompanied by nausea and vomiting. This therapeutic measure is by no means new, having been described originally several decades ago. The recent literature, however, indicates a reawakening of interest in the method.

Intravenous Ether—Ethyl ether can be injected intravenously in 5 per cent solution for the production of anesthesia.²⁴ Hemoglobinuria, pain at the site of injection and difficulty in obtaining a homogenous and sufficiently concentrated solution have been deterrents to more widespread adoption of the method. An interesting application recently has been the treatment of peripheral vascular disease particularly arterial occlusion with intravenous ether.²⁵ Twenty five to 50 cc of anesthetic ether is added to 950 cc of saline and the mixture is thoroughly shaken. Injection requires three to four hours. A blood stream concentration of only a few milligrams per 100 cc is attained and a systemic response to the narcotic is rarely noted. Pain relief, the healing of indolent ulcers and increased blood supply to the part have been described. Daily injection or injections at least every other day are essential for several weeks. Results are encouraging in certain patients particularly in those with rest pain. More work must be done however before an accurate appraisal can be made of this technique.

PEDIATRIC ANESTHESIA

The work of Ladd, Gross and others in the development of surgical procedures for infants and children has necessitated simultaneous improvement in techniques of anesthesia for these tiny patients who have circulatory and respiratory problems peculiar to their age. Maintenance of body temperature which may either fall sharply or rise to alarming levels is a constant concern. The volume and type of fluid to be administered intravenously has received much attention and adequate management of this phase of supportive therapy has done much to improve the operative and postoperative course of the children. Fluids are generally administered by vein even to the newborn. Cannulation of the vein is often essential to guarantee flow. The problem of preoperative medication has also been carefully evaluated.²⁶ Dosage tables have been developed and individualization is possible on a rational basis. Opiates, barbiturates and belladonna derivatives are used just as in adults with doses adjusted according to age, weight, general physical condition and type of anesthesia.

All types of anesthetic agents and technique can be administered to these patients. The important criteria for selection have been the clinical experience of the individual anesthetist. This experience has led the way in outlining the

tent claudication, acute superficial migratory phlebitis peripheral arteriosclerosis obliterans, causalgia, post traumatic edema, reflex sympathetic dystrophy and thrombophlebitis

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Intravenous Alcohol.—Five to 10 per cent alcohol in glucose or per cent five
to 10 cc. v
discomfort, in the management of delirium tremens and to increase caloric intake. One thousand cc. of 5 per cent alcohol solution pro-

The future possibilities of hypnosis³⁰ and electrical anesthesia stimulate the imagination. Relief of pain by methods is unconventional and radical as these may be developed fully within the next few decades. Since anesthesia by means of electricity is so unexplored, yet so tempting, one wonders if future "recent advances" will deal with stimulators, voltages, and resistances rather than with the relatively commonplace items presented in this article.

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They have shown the medical profession what can be done under ideal circumstances. This subdivision of anesthesiology deserves greater study by surgeons. The days of "open drop ether" alone for infants and children is past. For such procedures as cleft palate repair, repair of tracheoesophageal fistulas, diaphragmatic hernias and other operations the patient as well as the surgeon deserves the benefit of an anesthetist skilled in the management of the very young.

THE PHYSICIAN ANESTHETIST

Perhaps the most significant "recent advance in anesthesia" has been the recognition of the contribution which can be made by physicians specializing in anesthesiology. World War II provided impetus for the training of young men in this specialty and their value as part of the surgical team is now established on a sound foundation. No longer need the surgeon divide his attention between the reaction of the patient to narcotics and surgical manipulation and the specific technical problem at hand. He can concentrate on the latter with full confidence that a physician well suited by special training is caring for his patient in the broadest sense of the term. An anesthesiologist sees a great many more surgical patients in the course of a year than does any single surgeon. Each day he critically studies the circulatory, respiratory and emotional responses of patients undergoing surgical intervention. On the basis of this experience he is qualified to judge

of body function which
can assess and interpret
which his patient may

present. Dealing constantly with drugs which produce profound alterations in circulation and respiration, he is daily concerned with the problems of reversing these changes.

No longer must anesthesia be regarded primarily as a challenge to the technician. Technical skill is essential but there can be no substitute for intelligence. The surgical patient today deserves supervision by an individual thoroughly versed in physiology and pharmacology, able to appreciate premonitory signs and symptoms and able to meet emergencies with reason rather than with reflex automatic reactions.

THE FUTURE

"advances in anesthesia." The fundamental problems of the nature of narcosis remain to be solved. The standard anesthetic agents need to be restudied with the new techniques of physiology, biophysics and chemistry. Waters and his colleagues have begun this reevaluation with a study of chloroform.²³

CURARE AND CURARE-LIKE COMPOUNDS

JULIUS H. COMPTON, JR., M.D., F.A.C.P.* AND ROBERT D. DRIFFS, M.D.†

UNTIL a few years ago, curare was known only as a laboratory curiosity. It had been known that the South American Indians had used it as an arrow poison, the poisonous substance acting to paralyze the animal before killing it. It had also been shown by Claude Bernard in 1857 that curare paralyzed by acting upon a tissue which was neither nerve nor muscle, thus he called the "neuromyal junction." Curare had always been regarded as a toxic drug and one to be avoided so far as clinical use is concerned, though it had considerable usefulness for experimental purposes. Its widespread clinical use today is largely due to the fact that Richard Gill organized a trip to South America and brought back large quantities of authenticated crude curare which were made by Squibb and Company into a curare compound called "Intocostrin." Though not completely pure, this was so standardized that for the first time curare could be given to patients with the expectation that a predictable effect would be produced. Within the last few years intocostrin has been further purified so that an active principle of curare (*d*-tubocurarine) is now available in crystalline form.

MODE OF ACTION OF CURARE

As indicated before, it has been known for almost a century that curare paralyzes the neuromuscular junction. Newer concepts of neuromuscular transmission have provided us with more detailed information regarding this effect. It is now widely believed that when a nerve impulse travels down a motor nerve trunk, it does not go directly to skeletal muscle but ends in a motor end plate (composed of "terminal buttons") which is in intimate contact with the specialized receptor of the muscle cell, often called the sole plate or muscle receptor substance. The motor nerve endings liberate a transmitter substance, acetylcholine, which in turn aids in the activation of the receptor substance of skeletal muscle. The evidence that acetylcholine is concerned with the transmission of the nerve impulse to the muscle has been obtained in several ways. First, if a nerve has been cut and

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The muscles affected first are the small, rapidly moving muscles such as the extraocular muscles, the eyelid muscles and the muscles of the middle ear whose paralysis leads to an increased sensitivity of hearing to low tones. The next group of muscles to be affected are the muscles of the neck, the swallowing muscles, the muscles of phonation, the muscles of the face, particularly those which are involved in smiling. With larger doses the muscles of the hands, arms and legs are weakened. Fortunately for physicians who use curare therapeutically the intercostal muscles and the diaphragm are paralyzed last of all. This differential action of curare, affecting fine muscles first and intercostal muscles and the diaphragm last, may possibly be explained on the premise that the fine muscles (eye, ear, etc.) receive impulses over their motor nerves at a more rapid rate than do the more coarse muscles.

In a normal individual the administration of curare may be a very unpleasant experience. The paralysis of the various muscles mentioned leads to double vision, ptosis of the eyelids, paralysis of the face and jaw muscles, tightness of the vocal cords, heaviness of the hands and legs and finally with larger doses of curare, depression of respiration. At a time when depression of respiration may be so profound that artificial respiration is necessary, the patient is still mentally clear and alert. It is of interest to note that the clinical picture of curare poisoning is almost identical with that seen in advanced cases of myasthenia gravis.

DURATION OF ACTION

The effects produced by a single, intravenous injection of curare appear to wear off within about twenty minutes if the clinical sign of increase in muscle tone of the abdominal wall is the test used. However, electromyographic recording of transmission through the neuromuscular junction which enables one to measure the duration of this action quantitatively, shows that some curare action persists for two to four hours. Animal experiments have also shown that some curare action persists even though the animal appears normal, for a second dose repeated within a few hours will curarize even though considerably smaller than the first dose. Therefore a second large dose of curare should not be repeated within a period of four hours.

CLINICAL USE OF CURARE

allowed to degenerate, nerve stimulation no longer produces acetylcholine or muscular contraction. Secondly, if the muscle is stimulated directly by electrodes rather than indirectly through its nerve, no acetylcholine is liberated.^{1*}

It has been shown that acetylcholine, liberated by normal motor nerve impulses, does not act upon all parts of the muscle.² In certain animals one can dissect out a unit consisting of a single muscle fiber with its attached motor nerve. The motor nerve endings and the receptor plate of the skeletal muscle can then be observed directly under the microscope. Under these conditions, acetylcholine, applied by a micropipette to various portions of the single muscle fiber, produces muscular contraction only when dropped on the receptor zone. This region of skeletal muscle may be likened to the sino-auricular node in heart muscle. It is the part of the skeletal muscle which has the highest degree of excitability, the impulse starts in the end plate region of skeletal muscle and then spreads throughout the muscle and causes it to contract.

In terms of the cholinergic concept, curare does not prevent the liberation of acetylcholine. If curare is applied in sufficient quantity to the muscle region, stimulation of the motor nerve will still liberate the same quantities of acetylcholine, but there will be no muscular contraction. How curare prevents the effects of acetylcholine and of nerve stimulation is still a matter for conjecture. It may be that curare attaches itself to the receptor substance of skeletal muscle and so prevents acetylcholine from affecting this specialized region. An alternate though less precise concept, is that curare merely raises the threshold of skeletal muscle to whatever stimuli may reach it.[†]

Curare is a remarkable drug in that it acts preferentially upon the neuromuscular junction in small doses. Given systemically to man curare affects the various muscle groups in highly characteristic order.

* It should not be thought that the liberation of acetylcholine is the only mechanism concerned in neuromuscular transmission. Some investigators believe that it plays a very minor role, transmission being effected largely by electrical

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† Carey³ attempted to explain the action of curare upon an "ameboid action"

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the cholinergic theory which would prevent the secretion or liberation of acetylcholine. Carey's results have not been confirmed by King and Willard⁴, however the technic is a very difficult one and results may be capricious.

tions. It has not yet been proved objectively that curare can reduce muscle spasm without producing muscle paralysis. Those who have argued in favor of this lissive action of curare believe curare has the ability to block stimuli of high frequency coming over the motor nerve to the skeletal muscle and that spasm, spasticity and rigidity are caused by nerve volleys of high frequency. This presupposes that normal movements of muscles are produced by impulses of relatively low frequency being discharged over the motor nerve and that such would be unaffected by small doses of curare. Carefully controlled studies of this "lissive" action should be carried out to see if neuromuscular depression is produced (without paralysis) or whether the effect is concerned not with the peripheral actions of curare but with other actions (possibly upon the brain or spinal cord).

TOXICITY

Any clinician who intends to use curare should first be familiar with its toxic potentialities. If these are not appreciated curare may indeed be a dangerous drug.

1 Curare should not be used in ordinary dosage in patients with myasthenia gravis. Such patients are sensitive to its action and may show very profound muscular depression with one tenth the dose of curare required to produce a similar degree of paralysis in a normal individual. High concentrations of ether exert a curare like effect, if curare is used to supplement ether anesthesia smaller doses of curare preparations should be used than with other anesthetic agents.^{10 11 12} A curare like effect has not been seen with cyclopropane nor with pentothal.¹²

2 Curare may produce asphyxia in several ways. It may actually depress the respiratory muscles to the point of respiratory failure. However it is more apt to produce asphyxia by obstruction. Pharyngeal muscles and laryngeal muscles become paralyzed rather early and obstruction to the passage of air may follow apposition of these diseases. In such cases asphyxia may occur at a time when respiratory movements still appear to be normal or exaggerated. Asphyxia may occasionally occur.

so that secretions
sons that curare
ministered by anesthesiologists since they are most experienced in the use of endotracheal tubes oxygen and artificial respiration. It is probably wise to give atropine along with curare in order to prevent excessive secretion which might be inhaled.

3 Another action of curare (which may also produce asphyxia) is its ability under certain circumstances to liberate histamine within the body. This effect was first seen in man following the intra arterial injection of curare.¹³ When curare was injected into the brachial artery of man for certain experimental purposes it was noted that huge

1 The chief indication for the paralyzing action of curare is to produce muscular relaxation during certain surgical procedures carried out under general anesthesia.⁵ Given intravenously by a technic of intermittent injections curare permits three things: (a) it provides relaxation of the muscles at the proper time, (b) it decreases the amount of anesthetic agents needed and therefore permits a smoother post-operative course and (c) it enables the anesthetist to administer less potent anesthetic agents such as pentothal and nitrous oxide which otherwise might not produce sufficient muscular relaxation. In contrast to the use of curariform drugs during an entire surgical procedure is the use of a single injection of these substances to produce a brief period of relaxation for a specific purpose. Thus curare may be administered to facilitate intubation of the trachea, insertion of a bronchoscope, closure of an abdominal incision if the anesthetic technic in use had proved inadequate (e.g., motor effect of spinal anesthesia wearing off). In short, wherever diminution or abolition of muscle tone is indicated curare may be of value. Another indication for the paralyzing action of curare on neuromuscular transmission is in electrical shock and convulsive therapy when it is desired to prevent severe convulsions and the fractures which may result therefrom.

2 Recently, smaller doses of curare (or slowly absorbed curare) have been employed to produce a mild depression of neuromuscular transmission rather than complete block. It is this which is referred to as the "lissive" action of the drug.⁶ Sufficient evidence has not yet accumulated in the literature to prove beyond doubt that curare is capable of blocking certain types of muscular movement without producing paralysis. MacIntyre⁷ believes that only certain types of curare possess this ability and that tubocurarine is not one of these. However, it is assumed by some investigators that curare preparations are able to block certain types of electrical impulses (abnormally rapid or abnormally prolonged) coming down the motor nerve without affecting those which produce normal motion. With this idea in mind curare has been used clinically to reduce the spasm of muscles associated with low back pain, with arthritis and with certain stages of poliomyelitis.⁸ Curare has also been used to decrease spasticity of skeletal muscle

erous system, in cases
In our opinion further
curare in these condi

* In this connection however a word of warning should be issued. It has been shown⁹ that patients with poliomyelitis not only have deterioration of anterior horn cells in the spinal cord but also may have a reduction in the number of motor end plates in skeletal muscle. This has been confirmed by the finding⁹ that some patients who have recovered partially from poliomyelitis often have electrical

ion As a rule this effect is not important clinically unless the depth of anesthesia is excessive

This list of toxic effects of curare should impress the clinician with the concept that though curare in small doses specifically paralyzes neuromuscular transmission it may have other actions in the body under special circumstances

ANTIDOTES

Reversal or partial neutralization of the curare action on the neuromuscular junction can be accomplished by the use of neostigmine (prostigmine) or physostigmine. The usual dose of neostigmine is 0.5 mg given intravenously. It must be realized that these drugs counteract only the paralytic action of curare substances upon skeletal muscle and not the hypotension or bronchoconstriction that may result from the liberation of histamine nor any effects upon the central nervous system. Neostigmine may actually intensify bronchoconstriction and hypotension. The most common sign of serious overdosage is respiratory depression, the measure which is most immediately helpful in such cases is artificial ventilation with oxygen. This is more useful than attempts to restore breathing by injection of prostigmine.

PREPARATIONS

1 **Crude Curare**—In a sense the term "crude" is a misnomer for *intocastrin* though still a mixture of alkaloids is much purer than any other solution previously available. Its yellowish color however suggests that substances such as resins may still be present. The solution is standardized for clinical use by bioassay. Dosage is in terms of units. For the production of muscular relaxation during general anesthesia 40 to 80 units may be required intravenously as an initial dose. This dose produces far less effect in the unanesthetized individual. As stated above doses of curariform compounds must be reduced when ethyl ether is being administered.

2 **D-tubocurarine Chloride**—This is the active principle chemically pure of one source of curare i.e. *Chondrodendron tomentosum*. The usual dose is 5 to 10 mg intravenously. It is distinguished from that of *α*-tubocurarine by the fact that the two drugs appear to be identical. Since *d*-tubocurarine is a dextrorotatory compound it would

wheals and flares covered the lower arm. This is attributed to the fact that high concentrations of curare can liberate histamine from the skin and muscles. Intra arterial injections of curare also lead to the production of increased hydrochloric acid in the gastric juice¹⁴ to bronchoconstriction and also to hypotension. All of these effects may be due to the liberation of histamine. Several remarks may be made regarding this bronchoconstriction. (a) It is not nearly so intense or frequent when curare is given intravenously and slowly. Severe bronchoconstriction is estimated to occur in approximately 0.3 per cent of patients receiving a curare preparation during general anesthesia. This relatively low incidence may be related to the fact that narcosis minimizes anaphylactic or allergic reactions in general. (b) This type of bronchoconstriction may be prevented by the use of antihistaminic agents such as benadryl and pyribenzamine.¹⁵ (c) If bronchoconstriction occurs along with respiratory paralysis it must be remembered that positive pressure will be needed to push air into the alveoli and prevent asphyxia.

4. Some investigators have noted that curare has a profound effect upon the central nervous system. Pick and Unna¹⁶ noted that curare produced marked cortical depression of the frog's brain as measured by electroencephalography. Whitacre and Fisher¹⁷ later noted that large doses of curare might act as an anesthetic agent in man presumably by depression of the cerebral cortex. However, Scott Smith¹⁸ gave large doses of tubocurarine and noted no effects upon the central nervous system in dosage far beyond that which was necessary to paralyze his respiration completely. Further experiments must be done in man in order to settle the controversial matter of the effect of tubocurarine and intocostin upon the central nervous system. These may conceivably produce a sedative or anesthetic effect in susceptible individuals or it is possible that the anesthetic effect is seen only with rapid intravenous administration. In the latter instance hypotension may contribute to the anesthetic effect. At any rate it has never been observed except with huge doses well outside the therapeutic range.

5. In experimental animals curare in large dosage blocks sympathetic ganglia all over the body. This effect has not yet been reported upon clinically. The dose required for this effect is so large that it will probably not be of therapeutic importance.

6. Those who have used curare extensively in animal experiments have been aware of its low toxicity. The number of subjects required to produce a fatal effect is large.

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